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ALLIED HEALTH DIVISION

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Contents

University Administration	iv
Board of Visitors of the Medical Center	iv

1 General Information 1

History	1
Resources for Study	2
Admissions	4
Student Life	5

2 Degree Granting Programs 7

Programs Offered	7
Bachelor of Health Science Degree	7
Medicole Technology	8
Pathology Assistant	11
Physician's Associate	14
Master's Degrees	17
Health Administration	18
Physical Therapy	20

3 Certificate Programs 25

Clinical Psychology Internship	25
Cytotechnology	27
Electrophysiological Technology	27
Health Administrator's Management	
Improvement Program	29
Hospital and Clinical Pharmacy Residency	31
Medical Speech Pathology	32
Nuclear Medicine Technology	33
Nurse Anesthesiology	36
Pastoral Care and Counseling	38
Physician's Associate	38
Radiation Therapy Technology	39
Radiologic Technology	41
Respiratory Therapy	43

4 Courses of Instruction 47

University Administration

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† Member of Duke University Board of Trustees.



1

General Information

History

In 1924, James Buchanan Duke established The Duke Endowment, and thus made possible the creation of Duke University.

I have selected Duke University as one of the principal objects of this trust because I recognize that education, when conducted along sane and practical, as opposed to dogmatic and theoretical, lines is, next to religion, the greatest civilizing influence.

I have selected hospitals as another of the principal objects of this trust because I recognize that they have become indispensable institutions, not only by way of ministering to the comfort of the sick, but in increasing the efficiency of mankind and prolonging human life. . . . I very much hope that the people will see to it that adequate and convenient hospitals are assured in their respective communities. . . . It is to these rural districts that we are to look in large measure for the bone and sinew of our country.

The School of Medicine and Duke Hospital, then a 400-bed facility, were opened in 1930 under the leadership of the first dean, Dr. Wilbert C. Davison. Today the hospital is one of the largest private hospitals in the South with over 800 beds. Duke University Medical Center has become a leader in contemporary medicine. By its continued dedication to educational programs, it has been closely involved in the development of the allied health field.

Programs in hospital administration and dietetics were initiated at the Medical Center in 1930. Programs in several disciplines, dealing primarily with the laboratory aspects of clinical medicine, began soon afterward. Due to marked advances in the field of medicine, new allied health programs were developed in the early 1960's to assist in the many medical specialities. Today there are over 300 students enrolled in Duke University allied health programs.

The Division of Allied Health officially represents the interests of these health-related educational programs by being their liaison with the entire medical complex. It coordinates all student and faculty activities within the Allied

Health Education Building and provides for such varied educational services as the planning and evaluation of courses and circulation of instructional materials.

Resources for Study

Libraries. The Perkins Library, among the finest university libraries in the country, contains over 2,333,000 volumes and 4,200,000 manuscripts. About 100,000 volumes are added annually. Separate departmental and professional school libraries provide notable collections in several disciplines.

The Medical Center Library, located in the Davison Building, attempts to provide all services and collections necessary to further educational research and clinical activities in the medical field. Extensive reference and bibliographic services are provided. The collection exceeds 117,000 volumes; 1,800 periodicals are also currently received. The Trent Collection on the history of medicine is an unusually fine collection of manuscripts and rare books and provides an opportunity for study, research, and casual reading.

The library in the Durham Veterans Administration Hospital contains over 3,000 books and receives 185 journals. It also supplies a reference and bibliographic service to both staff and residents. In addition, literature searches are made upon request.

The Media Learning Laboratory, located in the Allied Health Education Building, has ten study carrels equipped to handle audiovisual materials, including slides, videotapes, and 8mm loop films. Through this laboratory, individuals may also order audiovisual materials from both the Duke University and Veterans Administration hospitals.

Audiovisual Educational Facilities. Duke University Medical Center's Division of Audiovisual Education and the Veterans Administration Hospital's Medical Illustration Service have production facilities in medical art, photography, and television. These serve the allied health programs by providing all types of audiovisual materials for teaching, research, and patient care. The close working relationship that exists between the two production facilities has resulted in a two-channel television link. This provides transmission of a variety of educational programs, including Grand Rounds and Network of Continuing Medical Education (NCME), between the hospitals. Instruction in the use of audiovisual materials and methods is a part of the course of instruction in several of the allied health programs. Media workshops are also provided as requested by faculty and students.





Computing Facilities. The Duke University Computation Center provides faculty and students with a facility for research and instruction in computing. It is presently equipped with an IBM 370 Model 135 which is connected by high-speed lines to an IBM Model 165 located at the Triangle Universities Computation Center in the Research Triangle Park. In addition to the University's center, there are two medium speed terminals and several low-speed keyboard terminals available on the campus.

Hospitals. Duke University Hospital, an 800-bed facility, performs the dual functions of providing both patient care and professional education. Comprehensive diagnostic and treatment facilities are provided at various levels of patient care ranging from intensive to minimal care units. Private, semi-private, and ward accommodations are utilized by the more than 23,000 patients admitted each year. Special diagnostic and treatment units such as the cardiac catheterization laboratory, hemodialysis laboratory, and hyperbaric oxygenation chamber are also housed in the hospital. Outpatient services include the public clinics, private clinics, and the emergency service. Duke Hospital is fully accredited by the Joint Committee on Accreditation of Hospitals and is approved for internship and residency training by the Council on Medical Education of the American Medical Association.

The Durham Veterans Administration Hospital is located within walking distance of the Duke University Medical Center. All full-time professional staff members of the hospital are also members of the faculty of Duke University's School of Medicine. The Veterans Administration Hospital, a 489-bed facility, provides the Duke University Medical Center with an excellent opportunity for closely integrated student teaching and house staff training.

In May, 1973, the new Duke University Eye Center will open its doors as the first facility in the Southeast dedicated solely to the treatment of eye diseases and to concentrated ocular research.

Other patient care facilities directly affiliated with the Medical Center include the North Carolina Cerebral Palsy Hospital, a 40-bed residential rehabilitation center for children; Highland Hospital, a 125-bed psychiatric facility; and Sea Level Hospital, a 72-bed general hospital.

Several of the allied health programs have affiliations with other hospitals and medical institutions for clinical instruction.

Instructional Facilities. In 1971, the Veterans Administration opened a 15,000 square foot, two-story Allied Health Education Building. It provides a number of classrooms, laboratories, and offices especially designed for allied health education. A special emphasis has been placed upon the utilization of audiovisual materials in the instruction of students. These include the self-instructional media learning laboratory, closed-circuit television, and other support facilities. This building is kept open in the evenings and on weekends to accommodate students' needs.

Admissions

Qualifications. Applicants to all allied health programs are considered without regard to race, color, religion, sex, or national origin. Since enrollment is limited, admission to the programs is based on the academic record of the candidate, test scores, assessment of previous health-related experiences, and satisfactory evidence of good character and general fitness.

Fees and Expenses.* Students enrolled in the master degree programs pay \$78 per unit or approximately \$1170 per semester tuition. Those in the Bachelor of Health Science degree programs pay the standard Duke University undergraduate tuition of \$2600 per year. Registration fees for certificate programs, often referred to as tuition, vary and are described on pages 25-45. The estimated annual living expenses (housing, food, utilities, etc.) for a single person in Durham are \$4000; for a married couple \$5000-\$6000.

Student Aid. Federally insured guaranteed loans up to \$2500 are available to full-time allied health students through Duke University. Most programs are approved for Veterans education benefits (G. I. bill) for those who are eligible. Students are encouraged to pursue every available source of support through their local and state student loan and assistance programs. Many of the programs have some student support available through stipends, special scholarships, or tuition loan plans. Every effort will be made to assist the student with tuition and living expenses. However, as funds are very limited, prior indebtedness will not be given favorable consideration as part of the student's budget. Any applicant anticipating need for financial aid should consult with the director of his program or write: Coordinator, Financial Aid,

* These are current fees for the 1973-74 academic year; they are subject to change before the fall of 1974.

706 Davison Building, Box 3005, Duke University Medical Center, Durham, North Carolina 27710.

Dining Facilities. Several dining facilities located in and near the Medical Center are available to students. In the Duke University Union Building, there are two cafeterias and a dining room. There are also cafeterias in the Graduate Center and the Veterans Administration and Duke hospitals.

Student Health Service. The facilities of the University Health Services Clinic located in the Pickens Building are available year round to all allied health students. The clinic provides outpatient treatment, routine laboratory and X-ray examinations, and many other services. These benefits are provided free to students from the following programs who pay full Duke University tuition; Medical Technology, Pathology Assistant, Physician's Associate, Health Administration, and Physical Therapy. All other allied health students may purchase these services for \$4.64 per month. The coverage described above does not extend to spouses and children. However, dependents are eligible to use the facilities of the Duke University Medical Center, as are all members of the community, but they are responsible for health costs incurred. The clinic is open from 8:00 a.m.-8:00 p.m. Monday through Saturday and from 2:00 p.m.-8:00 p.m. on Sundays.

Student Health Insurance. In order to provide 24-hour protection to students for accidents and sicknesses not covered by the Student Health Services, the Student Accident and Sicknes Insurance policy is available. Benefits include payment of hospitalization and surgical and medical fees. Persons are covered on and off campus, at home, while traveling between home and school, and during interim vacation periods. The premium for a student for the year 1973-74 is \$32.90, for student and spouse is \$88, and for student, spouse, and child is \$110.

Student Life

Living Accommodations. Due to the shortage of residential space, students enrolled in allied health certificate programs are not presently eligible for dormitory accommodations. Currently, those transferring into Bachelor of Health Science degree programs are also ineligible for Duke University housing. Suitable living arrangements are available in areas near the medical complex. Information concerning off-campus housing is provided on request by the Department of Housing Management, Duke University, Durham, North Carolina 27706.

Athletic Events. All students paying the full Duke University undergraduate tuition of \$2600 are issued Duke University ID cards and may attend all home intercollegiate athletic contests. Graduate students and those enrolled in the certificate programs may purchase a \$25 book of tickets for regular season home football and basketball games. Those who purchase the \$25 graduate student book will also be entitled to purchase tickets to away Duke "Big Four" football games for one-half price.

Parking. All students planning to park vehicles on the Duke campus must register with the Traffic and Parking Department, 304 Bell Building. A parking fee of \$10 is charged and students are issued an H decal. For students not planning to park on campus until after March 1, the fee is \$5. Students must have a copy of their driver's license, car registration, and the name of their insurance company with them at the time they register.



2

Degree Granting Programs

Programs Offered

Duke University Medical Center grants a Bachelor of Health Science degree to students enrolled in the Medical Technology, Pathology Assistant, and Physician's Associate programs.

The Graduate School of Duke University grants a Master of Hospital Administration degree to students enrolled in the Health Administration program and a Master of Science degree to those enrolled in the Physical Therapy program.

Bachelor of Health Science Degree

In October, 1970, the faculty of Duke University approved the proposal that the Duke University Medical Center be empowered to give the Bachelor of Health Science (BHS) degree to students in certain allied health programs. The Physician's Associate program was the first to be approved to offer the new degree in November, 1971. In January, 1973, the Medical Technology and Pathology Assistant programs were also granted such approval.

All students transferring into these programs must have completed two years of study at an accredited institution. In addition they must have a minimum of sixteen course equivalents (60 semester hours) of C or better including at least one course in English, three in natural science, three in social studies or history, and one in humanities. To be eligible for graduation all students must have satisfied the physical education requirements of the University and have spent at least two years in residence at Duke.

All applicants must complete the Scholastic Aptitude Test (verbal and math portions). These tests are usually given in February, April, June, July,

November, and December. The Educational Testing Service code number for all allied health programs is 5174. Arrangements for taking these tests can be made through the applicant's college or by writing The College Entrance Examination Board, P.O. Box 1025, Berkeley, California 94701 or P.O. Box 592, Princeton, New Jersey 08540. It is strongly recommended that persons with test scores more than five years old retake this examination.

The procedures for admission are similar in all three Bachelor of Health Science degree programs. After the initial screening of applications has taken place, selected applicants will be invited to the Duke University Medical Center for a personal interview at the student's own expense. In cases where an interview in Durham is impossible, other arrangements may be made with the individual programs. All programs begin in the fall, and no students are accepted after the semester begins.

Medical Technology

ADMINISTRATION

Chairman, Department of Pathology: Thomas D. Kinney, M.D., R. J. Reynolds Professor and Director of Medical and Allied Health Education

Medical Director, Medical Technology Program: Frances K. Widmann, M.D., Assistant Professor of Pathology

Program Director: Mary S. Britt, MT(ASCP), M.S.

Education Coordinator: Margaret B. Schmidt, MT(ASCP), M.A.T.

FACULTY MEMBERS

Professor: Suydam Osterhout, M.D., Ph.D.

Assistant Professors: Marjorie A. Boeck, Ph.D.; Robert L. Habig, Ph.D.; George H. Spooner, Ph.D.; James W. Wilson, M.D., Ph.D.; and Peter Zwadyk, Ph.D.

Associates: John A. Bittikofer, Ph.D. and Kenneth R. Broda, M.A.

Teaching Staff: Donna L. Orti, MT(ASCP); Ardell M. Proctor, MT(ASCP), M.S.; Cynthia L. Wells MT(ASCP)

Clinical Teaching Staff: Edwin M. Bumgarner, MT(ASCP), M.P.H.; Jean T. Crute, MT(ASCP); Anne L. Finch, MT(ASCP); Claude M. Harrison, M.S.; Robert L. Hoover, B.S.; Norma J. Lester, MT(ASCP); John P. Pickett, HT(ASCP); Robert F. Wildermann, B.S.; and Irene A. Wyatt, MT(ASCP)

This program provides instruction in the performance of laboratory procedures which yield patient data used in determining the extent or absence of disease and in evaluating the effectiveness of treatment. The curriculum is structured so that the student may apply his scientific knowledge and skill to specific clinical situations in working with precision instruments and automated electronic equipment. Courses and seminars in educational techniques and laboratory supervision are included in the curriculum.

Program of Study. The two year baccalaureate program consists of courses which follow the academic calendar for the junior year and are scheduled from June until May commencement in the senior year. In the junior year, two required and two elective courses are taken each semester. Prior to admission to the senior year, students must obtain approved evaluations of their college transcripts from the Board of Schools, American Society of Clinical Pathologists. This is a requirement for all medical technology programs which are accredited by the Council on Medical Education of the American Medical Association. During the summer, students attend four didactic courses and participate in student laboratories. The remaining nine months of the program are spent in didactic courses and student and clinical laboratories.

Curriculum. Students must complete the following:

Junior Year

Fall Semester		Course Weight
PHS 180	Human Physiology	1
PTH 103	Introduction to Laboratory Technique and Basic Physical Principles	1
	*Plus two courses in the arts and sciences	

Spring Semester

CHS 151	Medical Uses of the Computer	1
PTH 107	Human Pathology	1

*Plus two courses in the arts and sciences

Senior Year

Summer Semester

PTH 202	Instrumentation	1
PTH 210	Immunology and Immunohematology	1
PTH 211	Blood and Body Fluids	1
PTH 232	Medical Microbiology	1

Fall Semester

PTH 204	Medical Chemistry	1
PTH 212	Parasitology	½

Two clinical laboratory courses to be assigned from the following: PTH 206, 208, 209, 231 ½ each

Spring Semester

PTH 224	Educational Technique for the Health Professional	½
PTH 226	Laboratory Supervision and Management	½
PTH 229	Student Seminar	½

Two clinical laboratory courses to be assigned from the following: PTH 206, 208, 209, 231 ½ each

Complete course descriptions may be found on pages 47-50.

* Courses should be selected to fulfill basic prerequisites in the biological sciences or chemistry. Suggested courses include: Botany 103, 156, Zoology 180, 243, 248; Psychology 93; Political Science 139; Sociology 141; History 158; or Community Health Science 229.





Prerequisites for Admission. Applicants to the baccalaureate program must satisfy the general admission requirements for the Bachelor of Health Science degree and must have earned at least a C+ average in their science courses. A total of four courses (sixteen semester or twenty-four quarter hours) is required in chemistry; at least one course must be in organic chemistry and one in quantitative analysis. Two courses (eight semester or twelve quarter hours) in biology and one course in college mathematics are also required. Additional biological science courses may be selected from among the following: comparative anatomy, genetics, immunology, physiology, bacteriology, histology, or parasitology.

Application Procedures. Applications must be submitted by February 1 of the year for which admission is requested and must contain the following:

1. A completed Duke University Medical Center Allied Health application form, including a non-refundable fee of \$20;
2. Official transcripts from all colleges and universities or other academic institutions attended;
3. Scholastic Aptitude Test scores from the College Entrance Examination Board; and
4. Three letters of recommendation, one from a professor of biological sciences, one from a professor of chemistry, and one from a college adviser.

All applicants will be notified by April 15 regarding admission to the program. Requests for further information and application forms should be directed to: Program Director, Medical Technology Program, Duke University Medical Center, Durham, North Carolina 27710.

Special Expenses. Textbook expenses for the first year are approximately \$100; for the second year, \$125. The cost of uniforms for the second year is approximately \$100.

Financial Aid. A small amount of University loan funds is available. In addition, residents of North Carolina may obtain financial aid from the North Carolina Medical Care Commission.

Pathology Assistant

ADMINISTRATION AND FACULTY

Professor: Thomas D. Kinney, M.D., Chairman, Department of Pathology

Professor: Philip C. Pratt, M.D., Director, Pathology Assistant Program

Associate: Kenneth R. Broda, M.A., Associate Director, Pathology Assistant Program

Professor: Donald B. Hackel, M.D.

Assistant Professor: James W. Wilson, M.D., Ph.D.

CLINICAL STAFF

Assistant Professor: Peter Zwadyk, Ph.D.

Associate: John P. Pickett, HT (ASCP)

Chief, Medical Illustration Service (VAH): Floyd Willard, B.S., R.B.P.

The Pathology Assistant Program is designed to meet the growing need for trained personnel to assist the pathologist in the areas of clinical diagnosis and anatomical pathology. Upon completion of the program, the student will have acquired knowledge and skills that will permit him to fill an important role in the medical field. The pathologist is a physician and scientist whose primary functions are the study, research, and diagnosis of disease. He customarily has the responsibility for the direction of the clinical anatomical pathology and surgical pathology services in the hospital.

Program of Study. The two year Bachelor of Health Science degree program consists of four semesters of didactic and laboratory courses. To fulfill certification requirements, each student must also complete two (3 month each) summer externships in affiliated departments of pathology.

Curriculum. Students must complete the following:



Junior Year

Fall Semester		Course	Weight
ANA 207	Human Anatomy	1	
PHS 180	Basic Human Physiology	1	
PTH 102	Histopathological Technique	1	
PTH 103	Introduction to Laboratory Technique and Basic Physical Principles	1	
	Introduction to Pathology: Basic Hematology	1/2	
PTH 105	Basic Pathology	1/2	
PTH 106			
Spring Semester			
MIC 106	Introductory Microbiology	1/2	
PTH 200	Pathology	2	
	Practical Technology Rotations: Autopsy Technology	1 1/2	
PTH 205	Histologic Technology	1	
PTH 213			

Senior Year

Fall Semester		Course	Weight
PTH 110	Systemic Pathology	1	
PTH 207	Medical Photographic Technology (Practical Technology Rotation)	1 1/2	
Two elective courses*		2	
Spring Semester			
PTH 230	Clinical Diagnostic Methods	1	
PTH 237	Surgical Pathology	1	
Two elective courses*		2	

Two summer externships arranged by the Pathology Assistant program.

Complete course descriptions may be found on pages 50-54.

*Electives can be chosen from either undergraduate junior or senior level courses which have been approved by the department or approved medical school elective courses offered by the Department of Pathology.

Prerequisites for Admission. There are no specific prerequisites other than those for transfer students explained on page 7 of this Bulletin. However, since enrollment is very limited selection is based on the applicant's past scores, health-related experiences, and evidence of his general aptitude and capability as indicated by the letters of recommendation.

Application Procedures. Applications must be submitted by May 1 of the year for which admission is requested and must contain the following:

1. A completed Duke University Medical Center Allied Health application form, which includes a non-refundable fee of \$20;
2. Official transcripts from the Armed Forces and all high schools, colleges, or other academic institutions attended;
3. Scholastic Aptitude Test scores from the College Entrance Examination Board; and



4. Three letters of recommendation, one from a science professor and the remaining from individuals who have definite knowledge of the student's professional or educational qualifications.

All applicants will be notified by June 1 regarding admission to the program. Requests for further information and application forms should be directed to: Kenneth R. Broda, Associate Director, Pathology Assistant Program, Department of Pathology, Duke University Medical Center, Durham, North Carolina 27710.

Special Expenses. Books will cost approximately \$150 and the required uniforms about \$50.

Financial Aid. Students who have been accepted officially and have demonstrated a definite need will be eligible to receive a \$200 per month scholarship granted by the Veterans Administration Hospital. This is in addition to those student loans explained on page 4.

Physician's Associate

P H Y S I C I A N ' S A S S O C I A T E P R O G R A M A D M I N I S T R A T I O N A N D C O U R S E D I R E C T O R S

Acting Director: E. Harvey Estes, Jr., M.D., Professor and Chairman, Department of Community Health Sciences

Medical Director: Jay S. Skyler, M.D., Associate in Medicine and Community Health Sciences

Surgical Director: Sewell H. Dixson, Jr., M.D., Instructor and Teaching Scholar of Surgery

Associate Director: Reginald D. Carter, Ph.D., Assistant Professor of Physiology and Community Health Sciences

Assistant Director of Education: John J. McQueary, R.P.A.

Coordinator of Surgical Services: Paul S. Toth, B.S., R.P.A.

Coordinator of Medical Services: Wayne A. Wright, B.A., R.P.A.

Assistant Director for Legal Affairs: Christine M. Durham, J.D.

Director of Finances: Edward H. Pope

Professors: William Harlan, M.D., Siegfried Heyden, M.D., and Suydam Osterhout, M.D., Ph.D.

Associate Professor: Gert H. Brieger, M.D., Ph.D.

Assistant Professors: Charles Blake, Ph.D.; Marjorie A. Boeck, Ph.D.; Francis A. Neelon, M.D.; Lois A. Pounds, M.D.; Gerald Rosen, Ph.D.; Mike Rosenthal, Ph.D.; Marvin J. Short, M.D.; George H. Spooner, Ph.D.; and Thomas T. Thompson, M.D.

Associate: Philip McHale, Ph.D.

P H Y S I C I A N ' S A S S O C I A T E P R O G R A M A D V I S O R Y B O A R D

Eugene A. Stead, Jr., M.D., Professor of Medicine, Chief Advisory Consultant

James C. Mau, B.S., Administrative Director, Department of Medicine and Advisory Consultant
Arthur C. Christakos, M.D., Associate Professor of Obstetrics and Gynecology and of Community Health Sciences

Sewell H. Dixson, M.D., Instructor and Teaching Scholar of Surgery

Daniel T. Gianturco, M.D., Assistant Professor of Psychiatry and of Community Health Sciences
John D. Laszlo, M.D., Professor of Medicine

Lois A. Pounds, M.D., Assistant Professor of Pediatrics and of Community Health Sciences

Lawrence K. Thompson, M.D., Assistant Professor of Plastic and Maxillofacial Surgery

Thomas T. Thompson, M.D., Assistant Professor of Radiology and Community Health Sciences

More than a decade ago clinicians at the Duke University Medical Center concerned with the application of new diagnostic and therapeutic procedures found they could safely and effectively delegate many of their tasks to non-physicians. Because of the scarcity of nurses and other allied health professionals, the specialists relied primarily on ex-military corpsmen, with previous health-related education and experience. Dr. Eugene A. Stead, Jr., then Chairman of the Department of Medicine at Duke, recognized the potential of the corpsmen experiment and concluded that the clinicians' use of military paramedical personnel might be adapted readily to augment the primary care physician in an effort to solve the health care shortage dilemma.

The physician's associate possesses a broad understanding of medicine and is capable of approaching a patient, eliciting a complete history, and performing a thorough examination, organizing the data, and presenting it in such a way that a physician can visualize the medical problem. He then assists the physician in performing the appropriate diagnostic and therapeutic procedures. In addition, physicians' associates provide patient care services such as cast application and removal, wound suturing, dressing changes, after-hour laboratory studies, and assessing and monitoring the progress of ill patients. Duke University Medical Center offers a certificate to those students who meet the requirements of the Physician's Associate Program, but do not have the necessary number of undergraduate hours to qualify for the Bachelor of Health Science degree.

Program of Study. The curriculum is twenty-four consecutive months

and has been developed to provide all students with an in-depth understanding of the medical sciences and their application to a clinical discipline. It consists of nine months of course work in basic medical sciences followed by fifteen months of clinical work. All students are required to complete eight weeks of inpatient service and eight weeks of outpatient and emergency service. Students must also complete forty weeks of elective clinical experience in family practice, internal medicine, pediatrics, surgery, and obstetrics and gynecology. Because the clinical teaching is carried out in many varied settings students should plan on being away from the Durham area for part of their clinical experience.

Curriculum. Before proceedings into the clinical phase of the curriculum, students must satisfactorily complete the following:

Pre-clinical Schedule

		Course Weight
Fall Semester		
ANA 207	Basic Human Anatomy	1
PHS 180	Basic Human Physiology	1
PTH 101	Basic Clinical Chemistry	1
PTH 103	Laboratory Technique	1
MED 110	Clinical Medicine	4
MED 120	Patient Evaluation I	1
Spring Semester		
PHS 104	Introductory Pharmacology	1
MIC 106	Introductory Microbiology	½
PTH 107	Human Pathology	1
RAD 108	Introductory Radiology	½
SUR/MED 109	Experimental Surgery/Electrocardiography	1
MED 111	Clinical Medicine II	
MED 121	Patient Evaluation II	
Electives		
CHS 270	Community Health Sciences	½
MED 240	Human Interaction	½

After satisfactory completion of all basic science courses, students must complete the following:

Clinical Schedule

General Inpatient Service	8 weeks
General Outpatient/Emergency	8 weeks
Four Elective courses*	32 weeks
Primary Care Medicine+	10 weeks

Complete course descriptions may be found on pages 54-67.

* Selection of electives is determined in accordance with specialty training guidelines from a number of 4 or 8 week rotations.

+ This rotation is taken only during the summer of the last year.

Prerequisites for Admission. Applicants must have met all the requirements for transfer students to Duke University plus have taken an acceptable college level course in chemistry and biology. Students must have a minimum of 2,000 hours in the health field involving direct and in-depth patient contact. Experience gained as a medical corpsman, medical technologist, radiologic



technologist, registered/practical nurse, inhalation therapist, or in other medical fields also fulfill this requirement.

Application Procedures. Applications must be submitted by February 1 of the year for which admission is requested and must contain the following:

1. A completed Duke University Medical Center Allied Health application form, which includes a non-refundable fee of \$20;
2. Official transcripts from the Armed Forces and all high schools, colleges, or other academic institutions attended;
3. Scholastic Aptitude Test scores of the College Entrance Examination Board; and
4. Three letters of recommendation, one from an immediate supervisor, one from a doctor with whom the applicant has worked, and one from an acquaintance of five or more years.

All applicants will be notified by April 1 regarding admission to the program. Requests for further information and application forms should be directed to: Director of Admissions, Physician's Associate Program, P.O. Box 2914, Community Health Sciences, Duke University Medical Center, Durham, North Carolina 27710.

Special Expenses. Books for the program will cost approximately \$160, equipment \$235, and uniforms \$70.

Financial Aid. It is possible to receive the entire amount of tuition through the Duke University tuition loan plan. However, due to the limited amount of money available, requests are considered individually and approved on the basis of financial need. The Physician's Associate Program has limited funds available for defraying living expenses, and these are also distributed on the basis of need. This should not be relied on, however, as a student's total means of subsistence. Part-time employment for students is available in many areas of the Medical Center. Frequently such employment can net students about \$100 per month and not jeopardize their education. Students must comply with the academic schedule and are prohibited from working more than fifteen hours per week.



Master's Degrees

Health Administration and Physical Therapy are departments of the Duke University Graduate School. Information about the graduate school is found in its bulletin which is available through: Office of Admissions, The Graduate School, Duke University, Durham, North Carolina 27706.

Information on times and places for applicants taking either the Aptitude Test of the Graduate Record Examination for the Physical Therapy program or the Admission Test for Graduate Study in Business for the Health Administration program is available from the applicant's college or from the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704.

Both Health Administration and Physical Therapy follow similar admission procedures. After the initial screening of applications has taken place, selected applicants will be invited to the Duke University Medical Center for a personal interview at the student's own expense. In cases where an interview in Durham is impossible, arrangements may be made by the program to have a regional representative meet with the candidate at a more convenient location.

Health Administration

Associate Professor: B. Jon Jaeger, Ph.D., Chairman, Department of Health Administration
Assistant Professor: Donald S. Smith, M.H.A., Director of Graduate Studies
Professor: Stuart M. Sessions, M.D.
Associate Professor: Louis E. Swanson, A.B.
Adjunct Professor: John T. Gentry, M.D.
Adjunct Associate Professor: Elizabeth J. Coulter, Ph.D.
Adjunct Assistant Professors: Arnold D. Kaluzny, Ph.D. and Richard H. Peck, M.H.A.
Lecturer: Jeff H. Steinert

The profession of health administration emerged early in this century in response to the increasing demand for health services. Over the years several specific areas of health administration have been identified, most notably, public health administration, hospital administration, medical care organization, and comprehensive health planning. All of these require a common set of managerial skills and a broad knowledge of the health system and its environment. It has been estimated that the system requires approximately 50,000 individuals in positions involving health administration. In recognition of the complexity and importance of hospitals, Duke University established the first graduate program in the nation for the training of hospital administrators in 1930.

Program of Study. Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-one month academic program that leads to the Master of Hospital Administration degree. The academic portion is composed of five continuous semesters of graduate work of which thirty-six units are within the department, nine units are in other departments of the Graduate School, and thirty units are in courses offered through the Graduate School of Business Administration. Students without previous administrative experience in the health field are strongly encouraged to undertake a twelve month administrative residency following graduation. The residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests.



Curriculum. All students must complete the following:

First Year

Fall Semester

HA 301	The Health System and Its Environment
MS 300	Managerial Economics
MS 310	Mathematics for Management
MS 330	Accounting and Control Systems

Spring Semester

HA 312	Comparative Health Systems
MS 302	Planning and Internal Organization
MS 311	Probability and Statistics
MS 320	Organization Analysis and Operations Design

Second Year

Summer

MS 312	Operations Research
HA 322	Public Policy and Health Care
HA 324	Institutional Health Services
HA 329	The Practicum

Fall

HA 335	Ambulatory Health Services
HA 339	The Practicum
	Management Concentration (Course I)
	Behavioral Sequence (Course I)
	Health Sciences Elective

Spring Semester

HA 346	Community Health Services
HA 348	Legal and Regulatory Constraints on Health Services
HA 349	The Practicum
	Management Concentration (Course II)
	Behavioral Sequence (Course II)

Third Year

HA 350	The Administrative Residency
HA 360	Seminar in Health Administration

Complete course descriptions may be found on pages 68-71.

Prerequisites for Admission. Applicants should have earned a baccalaureate degree from an accredited institution. Neither prior experience in health administration nor any particular undergraduate major is necessary. The only specific course prerequisite is one year of college-level calculus. However, individuals who have not had calculus, or whose preparation in mathematics is not adequate, can be admitted to the program provided they successfully complete a mathematics course in the summer offered jointly by the Department of Economics and the Graduate School of Business Administration. The essential criteria for selection are the applicant's potential to assume a leadership role in the organization and management of health care services and a demonstrated ability to complete satisfactorily the graduate curriculum.

Application Procedures. Applications must contain the following:

1. A completed Graduate School application form, which includes a non-refundable fee of \$15;
2. Two official transcripts from each institution of higher learning attended;
3. Test results from the Educational Testing Service on the Admission Test for Graduate Study in Business; and
4. Three letters of recommendation.

Final decisions on the admission of applicants begin the first week in March, and applicants are notified of the action taken on their application as soon as a decision is made. Applications received later than this date will be considered promptly if class vacancies exist. Applicants who request financial awards must have their applications, with all supporting documents, filed by March 1. Requests for further information and application forms should be directed to: Admissions Committee, Department of Health Administration, Box 3018, Duke University Medical Center, Durham, North Carolina 27710.

Financial Aid. Individuals needing assistance should discuss their situations with the department at the time of interview. Several graduate scholarships are available through the department. These include Duke University Graduate Scholarships, the Marshall I. and Sarah W. Pickens Scholarship that provides a \$2,400 award, the Foster G. McGaw Scholarship that provides a \$1,000 award, and the Equitable Life Assurance Society of the United States Scholarship that provides a \$1,000 award. Loan aid is available to students in the department from funds established by the W. K. Kellogg Foundation and the A. S. Aloe Charitable Trust.

Physical Therapy

Acting Chairman and Director of Graduate Studies: Jane S. Mathews, M.P.H.

Associate Professor: Eleanor F. Branch, Ph.D.

Assistant Professors: Grace C. Horton, B.S.; Jane S. Mathews, M.P.H.; and Elia E. Villanueva, M.A.

Associates: Nell L. Deaver, B.S.; Betsy J. Denny, B.S.; Elaine M. Eckel, B.S.; Robert A. Federchuck, B.A.; Marcia J. Roses, B.S.; and Patricia B. Rouse, B.S.

Special Lecturer: Rachel L. Nunley, M.A.

Professor Emeritus: Helen L. Kaiser, P.T.

Adjunct Professor: John T. Gentry, M.D., M.P.H.





The Master of Science degree program is designed to provide a broad foundation in the art and science of physical therapy and to provide opportunities for the development of skills in health administration and supervision, curriculum development and directed teaching in physical therapy, and in advanced clinical education or research. The program is approved by the Council on Medical Education of the American Medical Association in collaboration with the American Physical Therapy Association.

Program of Study. Completion of the curriculum requires two academic years and a summer practicum totaling fifty-two units (minimum) of graduate course work or equivalent academic exercise. Thirty to thirty-two units are in physical therapy, twelve in designated courses in anatomy and physiology, and the remainder in electives in related fields.



Curriculum. Students must complete the following:

First Year

Fall Semester

PT 217	Physical Therapy Dynamics I
PHS 200	Physiology of Man
ANA 300	Gross Anatomy

Spring Semester

PT 218	Physical Therapy Dynamics II
PT 230	Physical Evaluation and Instrumentation
PT 236	Medical Sciences
PT 238	Introduction to Health Service Systems
PT 242	Directed Clinical Experience in Physical Therapy I

Summer Semester

PT 220	Physical Therapy Dynamics III
PT 242	Directed Clinical Experience in Physical Therapy I (continuation)

Second Year

Fall Semester

PT 301	Introduction to Scientific Inquiry
PT 332	Administration of Physical Therapy Services

Plus nine credit hours of electives.

Spring Semester

PT 243	Directed Clinical Experience in Physical Therapy II
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Complete course descriptions may be found on pages 71-73.

Prerequisites for Admission. Requirements for admission are a baccalaureate degree and completion of prerequisite courses, although provisional acceptance can be approved if the major portion of the prerequisites have been completed at the time of application; final approval will depend upon satisfactory completion of the prerequisites before enrollment. A total of thirty hours is required in the field of natural science including 8-16 semester hours in the biological sciences; 8-16 semester hours in chemistry, with a course in biochemistry recommended; and 6-8 semester hours in physics. A total of 6 semester hours in mathematics is required, with at least one course in calculus recommended. A total of 15 semester hours is required in the fields of social science and humanities, of which 6 must be earned in psychology. In addition, a course in introductory statistics is recommended.

Application Procedures. Applications must be submitted by February 1 of the year for which admission is requested and must contain the following:

1. A completed Graduate School application form, which includes a non-refundable fee of \$15;
2. Two official transcripts from each institution of higher learning attended;
3. Test results from the Educational Testing Service on the Aptitude Test of the Graduate Record Examination; and
4. Three letters of recommendation, at least two of which should be from professors in the major field of study.

Requests for applications and further information should be directed to: Jane S. Mathews, Acting Chairman and Director of Graduate Studies, Department of Physical Therapy, Box 3247, Duke University Medical Center, Durham, North Carolina 27710.

Financial Aid. A limited number of traineeships are offered through the Social and Rehabilitation Service of the Department of Health, Education and Welfare; awards are made by the Scholarship Committee of the Department of Physical Therapy.



3

Certificate Programs

Duke University Medical Center has responded to the increased need for individuals at all levels in the health care system by developing educational programs designed to equip qualified people for these positions. The thirteen programs, varying in length from one to two years, offer the students both clinical and didactic experience. Certificates are presented to the graduates of each program. Due to the wide variety of available health-related positions, students with varying educational backgrounds will find interesting careers in the allied health field.

Clinical Psychology Internship

The Division of Medical Psychology, in cooperation with the Durham Child Guidance Clinic and the Durham Veterans Administration Hospital, offers internship training in clinical psychology to qualified doctoral students. The program, approved by the American Psychological Association, provides experience in many contexts with a wide diversity of patients. Internship training emphasizes experience in the traditional activities of clinical psychologists: assessment, psychotherapy, and research. Those successfully completing the requirements for internship will be awarded a Duke University Medical Center certificate.

Program of Study. The internship year is usually comprised of two service rotations of six months each, chosen from among six services: Psychiatric Inpatient, Day Care Unit, Psychiatric Outpatient Clinic, Psychophysiological and Psychosomatic Rotation, Neurology Rotation, and Child-Pediatric Rotation. Additional training includes individual psychotherapy with children and adults; group psychotherapy and experience in mental health consultation; participation in seminars, conferences, and in certain joint activities with nearby clinical installations; and opportunities for individual scholarship and research.



Application Procedures. There is no standard application form. Applicants should send a vitae, transcripts of graduate studies, a summary of specific professional experience, and a statement concerning future professional goals in clinical psychology. In addition, three letters of recommendation from faculty or supervisors are required. Each year approximately seven interns are accepted for training. Correspondence concerning admission to the program should be directed to: Dr. Derek Shows, Box 2995, Duke University Medical Center, Durham, North Carolina 27710.

Financial Aid. United States Public Health Service stipends of \$3,600 are available, plus a \$1,000 departmental supplement, but can only be awarded to students from graduate training programs in clinical psychology which are accredited by the Education and Training Board of the American Psychological Association or programs which have a National Institute of Mental Health program development grant. One Duke Hospital stipend of \$4,600 is also available. A dependency allowance of \$600 per dependent is provided where appropriate. Cooperative arrangements with the Veterans Administration Hospital can also be made.

Cytotechnology

Professor: William W. Johnston, M.D., Director, Cytotechnology Program
Associate: Patricia R. Ashton, A.B., C.T. (ASCP), Educational Coordinator, Cytotechnology Program

Progress in the early detection of cancer by the microscopic examination of smears of cell samplings, especially from the female genital tract, has resulted in the specialty of cytotechnology. The cytotechnologist deals with the technical and diagnostic aspects of exfoliative cytology. Graduates of the program are awarded a certificate and are eligible to take the certifying examinations given by the Registry of Medical Technologists of the American Society of Clinical Pathologists.

Program of Study. The twelve month program beginning in mid-September consists of two parts: the first half is primarily devoted to theoretical and practical exercises in the techniques of exfoliative cytology and interpretation of the clinical material; the last half is comprised of laboratory training in all aspects of exfoliative cytology.

Prerequisites for Admission. All applicants must have completed at least two years of college (sixty semester or ninety quarter hours) including at least twelve semester (eighteen quarter) hours in biology—anatomy, histology, zoology, botany, or physiology. Eight semester (twelve quarter) hours of biology plus four semester (six quarter) hours of another science, such as chemistry or physics will also fulfill this requirement. However, priority will be given to individuals with a Bachelor of Science or Bachelor of Arts degree or to ASCP certified medical technologists.

Application Procedures. Applications must be submitted by April 1 of the year for which admission is requested and must contain the following:

1. A completed application form;
2. Official transcripts from all colleges or professional schools attended;
3. One copy of all transcripts must be submitted by the applicant to the Board of Registry of the American Society of Clinical Pathologists for approval;
4. Two letters of recommendation from individuals acquainted with the applicant's educational or professional experiences; and
5. A personal interview prior to final acceptance.

All applicants will be notified by May 1 regarding admission to the program. Requests for further information and application forms should be directed to: William W. Johnston, M.D., Department of Pathology, Duke University Medical Center, Durham, North Carolina 27710.

Electrophysiological Technology

Professor: W. P. Wilson, M.D., Director, Electrophysiological Technology Program
Assistant Course Director: Rebecca Rhoads, R. EEG T.
Associate Professor: C. W. Erwin, M.D.
Assistant Professor: Ng Khye Weng, M.D.
Teaching Staff: E. M. G. Rankin, Perry Hope, R. EEG T. and the EEG Laboratory staff

In 1961, Duke University Medical Center began its formal program in electrophysiological technology as an expansion of the in-service training pro-



gram begun in 1955 at the Durham Veterans Administration Hospital. Every year the laboratories in the Medical Center perform over 4000 examinations including investigative procedures during brain surgery. Six students are accepted into the program each January and July. Upon successful completion of this program, graduates are awarded a certificate and become eligible to take the certifying examination given by the American Board of Registration of Electroencephalographic Technologists.

Program of Study. The first six months of this twelve month program are designed to instruct the student in basic electricity and electronics, as well as the use of electrophysiological recording equipment. The second six months consists of advanced instruction in instrumentation and electrophysiological recording techniques.

Prerequisites for Admission. All applicants must have a high school diploma, however, those with some college experience will receive priority.

Application Procedures. Applications must be submitted by April 1 of the year for which admission is requested and must contain the following:

1. A completed application form;
2. Results from the Scholastic Aptitude Test, if taken;
3. Three letters of recommendation, one from an individual acquainted with the applicant's character and the others from those acquainted with her/his educational or professional experience; and
4. A personal interview is desirable, but not required.

All applicants will be notified by April 15 regarding admission to the program. Requests for further information and application forms should be directed to: W. P. Wilson, Director, EEG Laboratory, Box 3355, Duke University Medical Center, Durham, North Carolina 27710.

Registration Fees and Expenses. A fee of \$150 is required of all students enrolled in the program.

Courses of Instruction. Students must complete the following courses:

Technical		
Title		Hours
Head marking and electrode application		20
Operation of machine		14
Laboratory procedures and application		100 (approx. 4-5 hrs. per day)
Electronics		24
Research procedures including operating room techniques		25
Radioisotope and radiological procedures		8
Electrocardiography		8
Neuroscience		
Neuroanatomy		15
Neurophysiology		12
Neurology, neurosurgery, psychiatry, and general medicine		20
EEG Interpretation		75

Health Administrators Management Improvement Program

Associate Professor: B. Jon Jaeger, Ph.D., Chairman, Department of Health Administration

Assistant Professor: Donald S. Smith, M.H.A., Director of Graduate Studies

Professor: Stuart M. Sessoms, M.D.

Associate Professor: Louis E. Swanson, A.B.

Adjunct Professor: John T. Gentry, M.D.

Adjunct Associate Professor: Elizabeth J. Coulter, Ph.D.

Adjunct Assistant Professors: Arnold D. Kaluzny, Ph.D. and Richard H. Peck, M.H.A.

Lecturer: Jeff H. Steinert

The Health Administrators Management Improvement Program (HAMIP) is conducted by the Department of Health Administration at Duke University specifically to strengthen the management skills of practicing hospital adminis-

trators who have not completed formal university-based education in hospital administration. It is designed to allow the working administrator to acquire skills and knowledge for more effective management of the hospital with a minimum of time away from his job. A certificate is awarded for successful completion of the program.

Program of Study. All classroom sessions in this one year program are held on the Duke University campus. The program consists of an initial one-week session, two-day sessions each month for eleven consecutive months, and a concluding one-week session, or a total of thirty full days on campus over a twelve month period. The HAMIP curriculum includes a structured home study program as well as lectures, seminars, and classroom work sessions while at the University. For each session there are assignments to be completed at home prior to class as well as follow-up work on the topics which have been discussed during the class session.

Prerequisites for Admission. All applicants must currently be employed in health organizations. Administrators, assistant administrators, and candidates for such positions in health organizations will be eligible to attend. No one holding a master's degree in hospital administration will be eligible for admission. Formal academic preparation is not a prerequisite. Priority is given to applicants from North and South Carolina; however, applicants from other states may be accepted. Students will be selected on the basis of two criteria: (1) how much he can benefit from the program, and (2) how much the student's participation in the program will help his hospital.

Admission Procedures. Applications must be submitted by June 15 of the year for which admission is requested and applicants will be notified by July 1 regarding their admission. Forms may be obtained from Donald S. Smith, Coordinator, Box 3018, Duke University Medical Center, Durham, North Carolina 27710.

Registration Fees and Expenses. Tuition for the program is \$1,200 which includes all required instructional materials. Upon acceptance, \$500 is required, the remainder to be paid when the program formally begins.

Financial Aid. Scholarship assistance representing approximately one-half of the tuition will be available to North Carolina and South Carolina students from non-profit organizations within the two states.





Hospital and Clinical Pharmacy Residency

Director: Milton W. Skolaut, B.S.

Assistant Director: Donald C. McLeod, M.S.

Assistant Director: E. Clyde Buchanan, M.S.

Associate: William H. Briner, B.S., Director of Radiopharmacy Laboratory

Residency Program. The Hospital and Clinical Pharmacy Residency is a twelve month post baccalaureate program conducted by the Department of Pharmacy, Duke Hospital, DUMC, Durham, North Carolina. The residency is designed to give the graduate pharmacist experience in the administrative aspects of hospital pharmacy management, and to offer advanced training in clinical pharmacy practice. Management of modern drug dispensing systems, such as unit dose drug distribution, intravenous admixture preparation, and hyperalimentation formulation, is emphasized. Considerable experience in the patient-care setting is also gained. Competency in clinical practice and the strengthening of leadership capabilities are stressed in the residency.

Admission Standards. A resident must be a graduate from a school of pharmacy and hold a B.S., M.S., or Pharm.D. degree. The resident must have demonstrated good academic and leadership capabilities. It is preferable that the applicant have previous hospital pharmacy experience.

Application Procedures. Applications must be submitted by February 1 of the year for which admission is requested. The following must be completed:

1. Personal interview, to be arranged by appointment;
2. Official transcript from school of pharmacy and other professional programs attended;



3. A completed DUMC employment application form; and
4. Letters of recommendation from at least three persons having known the applicant in a professional way (i.e., a professor, dean, pharmacist, or physician).

Applicants will be notified by March 15 regarding admission to the program.

Stipend. A stipend of \$10,000.00 is granted for the twelve month residency. This stipend is tax-deductible if the resident is enrolled in a graduate program requiring a residency for a degree.

Medical Speech Pathology

Associate Professor: Raymond Massengill, Jr., Ed.D., Director, Medical Speech Pathology
Professors: Kenneth Pickrell, M.D., Galen Quinn, D.D.S., M.S., and Nicholas Georgiade, M.D.,
D.D.S.

Assistant Professor: Larry Thompson, M.D.

Additional instruction is provided by Judy Giles, M.S.C.

The residency program in medical speech pathology is designed to help meet the need for speech pathologists trained to work in medical centers. Trainees will have graded responsibilities in the Speech Pathology Clinic which has patients referred for speech and language evaluations following neurosurgery, oral surgery, plastic and reconstructive surgery, and from many other services. In addition, stutterers, patients with articulation problems or delayed language development, and those with speech disorders related to dental anomalies are seen. A certificate from Duke University Medical Center is awarded to each graduate of the program.

Program of Study. Two students, designated as Speech Pathology Fellows, are accepted each year, one in September and the other in January. The period of training can be one or two years in length and can be utilized to collect basic research for their thesis or dissertation. In addition to working in the clinic, students may participate in the Cleft Palate Clinic, the research projects conducted in the Speech Research Laboratory, and the Summer Speech Residential Program which is held on the Duke University campus. They may also work in the research programs being conducted with participants from plastic and reconstructive surgery, orthodontics, oral surgery, neurosurgery, and other allied fields.

Prerequisites for Admission. Applicants must have completed academic training in speech pathology from an approved institution. Students with either baccalaureate or master's degrees are accepted.

Application Procedures. Applications must be submitted six months to one year in advance of the date for which admission is requested and must contain the following:

1. A completed application form;
2. Official university transcripts;
3. Three letters of recommendation, one from an individual acquainted with the applicant's character, one from an individual who has supervised his/her work, and one from his/her major professor; and
4. A personal interview is requested.

Applicants may be notified within eight months of their interview regarding admission to the program. Requests for application forms and further information should be directed to: Raymond Massengill, Jr., Ed.D., Associate Professor and Director, Medical Speech Pathology, Duke University Medical Center, Durham, North Carolina 27710.

Nuclear Medicine Technology

Professor: Richard G. Lester, M.D., Chairman, Department of Radiology

Professor: Jack K. Goodrich, M.D., Director, Division of Nuclear Medicine

Educational Director: Elizabeth C. Blackburn, M.Ed.

Professor: John C. Evans, M.D.

Associate Professors: Jack D. Davidson, M.D., C. Craig Harris, M.S., Robert H. Wilkinson, Jr., M.D., and Joseph B. Workman, M.D.

Assistant Professor: William H. Briner, B.S.

Associates: Fred P. Bruno, M.S. and Conrad Knight, B.S.

Instructional Supervisors: E. D. Flowers, R.T., N.M.T. and Martin C. Thomas, A.S., N.M.T.

Additional instruction is provided by the nuclear medicine residents and technical staff.

In the fall of 1967 the Division of Nuclear Medicine in the Department of Radiology of the Duke Medical Center began a full year program in Nuclear Medicine Technology. This program is approved by the American Medical Association, and upon completion of studies the student is awarded a certificate and becomes eligible to take the ARRT and RMT (ASCP) registry examinations in Nuclear Medicine Technology.

Program of Study. The program consists of twelve months of instruction and clinical training. The first three months are spent in courses involving both didactic and laboratory instruction. The following nine months are spent

in an internship. The student rotates through clinical areas in the Duke University and the Durham Veterans Administration hospitals.

Prerequisites for Admission. Applicants must be registered or registry-eligible radiologic technologists, medical technologists, or have an Associate of Arts/Science or Bachelor of Arts/Science degree from an accredited college. Due to the pace and scope of the subject matter presented, it is strongly recommended that students review the following areas prior to entry into the program: mathematics, use of the slide rule, general biology, chemistry, and physics.

Application Procedures. Applications must be submitted by May 1 of the year for which admission is requested and must contain the following:

1. A completed application form;
2. Official transcripts from all high schools, colleges, or professional schools attended;
3. Results from any standardized aptitude tests, such as PSAT, SAT, and ACT, taken by the applicant;
4. Three letters of recommendation from business or professional men and women, not related to the applicant, but who are acquainted with her/his educational or professional experiences; and
5. A personal interview is desirable, but not required.

All applicants will be notified by May 15 regarding admission to the program. Requests for further information and application forms should be directed to: Program Director for Nuclear Medicine Technology, Allied Health Education Building, Veterans Administration Hospital, Durham, North Carolina 27705.

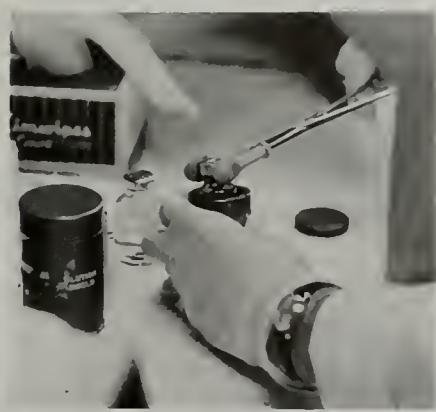
Registration Fees and Expenses. A registration fee (not the full Duke University tuition) of \$100.00 is required. Students must furnish their own uniforms; however, laboratory coats are provided by the program. In addition, books and supplies will cost approximately \$50.00.

Financial Aid. After successfully completing the first three months of course work, all students will be paid a monthly stipend of \$150.00 from Duke University Hospital for the remaining nine months of the program.

Courses of Instruction. Students must complete the following courses.

Title	Hours
Anatomy/Physiology/Pathology	70
Clinical Applications	80
Independent Study	5
Instrumentation	80
Mathematics Review	40
Nuclear and Radiation Physics	80
Orientation	15
Radiation Biology	15
Radiation Protection	15
Radiochemistry and Radiopharmacy	60
Student Seminars	40

In addition, assigned experience in clinical procedures will total 1400 hours.



Nurse Anesthesiology

Professor: Merel H. Harmel, M.D., Chairman, Department of Anesthesiology

Professor: Sara J. Dent, M.D.

Director: Mary B. Campbell, RN CRNA

Educational Director: Mary M. Gardner, RN CRNA

Instructor: Leola A. Glenn, RN CRNA

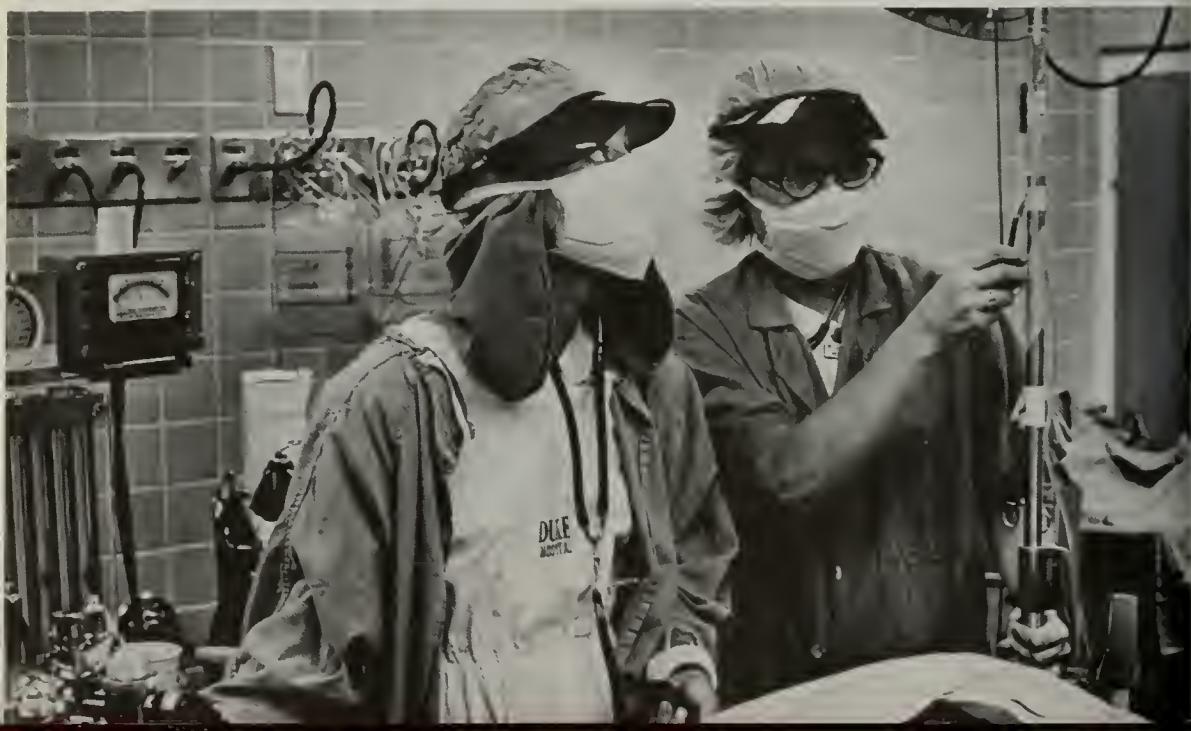
In 1931 Duke University Medical Center's Department of Anesthesiology established a program for registered nurses to further their study in anesthesiology. Students learn about the physiopharmacological effects of anesthesia and related drugs, the proper techniques for their administration, and the management of an entire treatment plan for patients requiring anesthesia. Upon successful completion of the required qualifying examination, graduates are eligible for membership in the American Association of Nurse Anesthetists.

Program of Study. The program beginning in January requires twenty-four months of training with the major portions of basic theoretical instruction given during the first three quarters. After eight weeks, students begin clinical practice while continuing their didactic studies. Most of the second year is concerned with clinical anesthesia. It is during this time that the students begin to work with cases which require more skill. Seminars are held twice a week and review examinations are given monthly.

Prerequisites for Admission. All applicants must be registered nurses. Priority is given to those with a year or more experience in the operating and/or recovery room.

Application Procedures. Applications must be submitted by June of the year prior to which admission is requested and must contain the following:

1. A completed application form, including a photograph;
2. Official transcripts from all nursing schools attended;
3. Four references; and
4. A personal interview.





Applicants will be notified by August regarding admission to the program. Requests for further information and application forms should be directed to: Mary B. Campbell, RN CRNA, P. O. Box 3094, Duke University Medical Center, Durham, North Carolina 27710.

Registration Fees and Expenses. A registration fee of \$150.00 is required of which \$50.00 is a deposit, the remainder to be paid at the time of enrollment. Books will cost approximately \$150.00 and miscellaneous expenses average \$50.00.

Financial Aid. A stipend of \$350.00 per month is paid to all students. In addition, scholarships are available to nurses registered in North Carolina. For further information concerning these scholarships contact the: North Carolina Medical Care Commission, P. O. Box 9594, Raleigh, North Carolina 27603.

Courses of Instruction. Students must complete courses in the following areas:

Title	Hours
Orientation	31
Anatomy and Physiology	146
Chemistry and Physics	124
Pharmacology	76
Methods and Procedures	73

Pastoral Care and Counseling

Assistant Professor: P. Wesley Aitken, B.D., Th.M., Director and Supervisor
Training Supervisor: John C. Detwiler, B.D., Th.M.
Professor: Richard A. Goodling, B.D., Ph.D.
Assistant Professor: Paul A. Mickey, B.D., Ph.D.

A graduate program in pastoral care and counseling is available to clergy of all religious groups. There are four program options: a single unit of Clinical Pastoral Education, an internship, a residency, and a fellowship. All are designed to train ordained individuals who desire to specialize in pastoral care and counseling or to enhance their skills as parish clergy. Those who enroll in the program will be required to serve as chaplains or as pastoral counselors in the Medical Center or in the community of Durham. All program options are approved by the Association for Clinical Pastoral Education, Inc.

Program of Study. For the internship, usually beginning in June and lasting twelve months, four units of Clinical Pastoral Education (CPE) with the ACPE are granted. Classroom studies are interspersed through the clinical phase of training by conferences and courses offered in the Medical Center and the Divinity School.

Prerequisites for Admission. Applicants to the internship must possess a college degree or its equivalent and have completed at least two years of theological education or its equivalent. Usually completion and supervisor's evaluation of one certified unit of CPE (basic unit) is required.

Application Procedures. Applications must be submitted by March 15 of the year for which admission is requested and must contain the following:

1. A completed application form and its supplementary materials; and
2. A personal interview with the supervisory and teaching staff.

All applicants will be notified by April 1 regarding admission to the program. Requests for application and further information about any of the programs should be directed to the Coordinator of Clergy Training, Box 3112, Duke University Medical Center, Durham, North Carolina 27710.

Registration Fees and Expenses. Individual units of training will cost \$150 for the first quarter and \$75 for each quarter thereafter. This fee is payable to the Chaplains Service at the beginning of each unit of training. Students who are taking CPE as part of the Master's degree program of the Divinity School will be charged tuition by the Divinity School instead of the \$75 fee for the fall, winter, and spring quarters. Upon acceptance, a deposit of \$25 is required, but will be deducted from the fees at the beginning of the program.

Financial Aid. A limited number of training stipends is available, \$2400 for the internship and \$3000 for the residency. No stipends are available for the single unit of training.

Physician's Associate

Students not eligible for the Bachelor of Health Science degree complete the curriculum for the certificate only. The two-year program is the same, including tuition, and is described in the second chapter. In addition, students

are issued a Duke University undergraduate identification card and are granted the same privileges as the Bachelor of Health Science degree physician's associate students. Only the prerequisites for admission differ in that, applicants not planning to receive the degree need not fulfill the lower division requirements for transfer students to Duke University. All other prerequisites are the same.

Radiation Therapy Technology

Professor: Richard G. Lester, M.D., Chairman, Department of Radiology

Professor: Patrick J. Cavanaugh, M.D., Director, Division of Radiation Therapy

Educational Director: Rebecca K. Mangum, A.A., R.T.

Professors: John C. Evans, M.D. and Fearghus O'Foghludha, Ph.D.

Associate Professor: Boyd T. Worde, M.D.

Assistant Professors: Norman Abramson, M.D.; Alice McCrea, M.S.; Thomas T. Thompson, M.D.; and Raymond U, Ph.D.

Associate: Conrad Knight, B.S.

Additional Teaching Staff: Gunilla Bentel, Dosimetrist; Elsie B. Coman, R.T.; Fay McNaull, R.N., M.P.H.; Karen Orsley, R.N.; Radiation Therapy residents, and technical staff

Therapeutic Radiology, a division of the Department of Radiology at Duke University Medical Center, is concerned primarily with the treatment of malignant disease. A program in radiation therapy technology was initiated in the fall of 1970. During training, the student technologist gains general knowledge and experience in the care of cancer patients, in dosimetric procedures, and in the technical aspects of treatment planning. Students also study the characteristics of tumors and the biological effects of ionizing radiation on normal and malignant cells and tissues. This provides a thorough background in the clinical, physical, and biological concepts of radiation therapy.

Each year more than 800 cases and 1,300 consultations are handled in the division, and over 17,000 external beam treatments and 80 intracavity



applications are performed. Equipment in the division at Duke includes a 6 Mev linear accelerator, a cobalt teletherapy unit, a cesium teletherapy unit, an orthovoltage machine, and a superficial voltage machine. In addition, equipment in the department at the Veterans Administration Hospital includes a cobalt teletherapy unit and an orthovoltage machine. Substantial intracavity radium and cesium encapsulated sources are available.

Program of Study. The twelve month program consists of 290 hours of lectures and 1650 hours of clinical training. Students attend class for one to two hours a day with the remaining time being spent on rotations through the clinical areas of Duke University Medical Center and the Veterans Administration Hospital.

Prerequisites for Admission. Applicants must be registered or registry-eligible radiologic technologists or nuclear medicine technologists or registered nurses who have had a college course in physics.

Application Procedures. Applications must be submitted by April 1 of the year for which admission is requested and must contain the following:

1. A completed application form;
2. Official transcripts from all high schools, colleges, or professional schools attended;
3. Results from any standardized aptitude tests, such as PSAT, SAT, and ACT, taken by the applicant;
4. Three letters of recommendation from business or professional men and women, not related to the applicant, but who are acquainted with her/his educational or professional experiences; and
5. A personal interview is desirable, but not required.

All applicants will be notified by May 1 regarding admission to the program. Requests for further information and application forms should be directed to: Assistant Director, Radiation Therapy Technology Program, Box 3275, Duke University Medical Center, Durham, North Carolina 27710.

Registration Fees and Expenses. A registration fee (tuition, not full Duke University tuition) of \$100.00 is required. In addition, books and supplies will cost approximately \$50.00.

Financial Aid. A stipend from the Veterans Administration Hospital of \$150.00 per month is paid to all students enrolled in the program.

Courses of Instruction. Students must complete the following courses:

Title	Hours
Introduction	3
Anatomy	16
Clinical Radiotherapy	20
Elementary Pathology	16
Ethics and Economics	13
Mathematics	20
Nursing Procedures	15
Physics	60
Protection and Shielding	15
Radiobiology	12
Radium Therapy	25
Treatment Planning	75



Radiologic Technology

The radiologic technology programs, the two-year certificate program at Duke and the Duke-Elon College Bachelor of Science degree program, will be phased out on September 1, 1974, with the currently enrolled students in both classes.

Duke will be offering a graduate-level certificate program in radiologic technology beginning between September, 1974 and 1975, accepting only graduate, registered radiologic technologists for an intensified program in higher education designed specifically to train students for administrative, supervisory, and special-procedure positions.

This new approach to higher education for radiologic technologists is brought about by the fact that the certificate, hospital-based program can, and is, being taught in 22 other hospitals located in North Carolina. Large medical centers are beginning to utilize more fully their resources and potential by training radiologic technologists on the graduate level for administrative positions and special procedures.

At the present time there are no other programs of this nature being offered. For further information on the graduate certificate program in Radiologic Technology, write: Director, Radiologic Technology Program, Education Building, Veterans Administration Hospital, Durham, North Carolina 27705, or Box 3108, Duke University Medical Center, Durham, North Carolina 27710.



Respiratory Therapy

Professor: Merel H. Harmel, M.D., Chairman, Department of Anesthesiology

Professor: Sara J. Dent, M.D., Medical Director, Division of Respiratory Therapy

Director: Houston R. Anderson, A.R.I.T., Division of Respiratory Therapy

Educational Coordinator: Thomas R. Morris, B.S., A.R.I.T.

Clinical Coordinator: Wayne R. MacKintosh, A.R.I.T.

Associate Professors: Douglas Blenkarn, M.D. and Samuel McMahon, M.D.

Assistant Professor: James W. Wilson, M.D., Ph.D.

Clinical Instructors: Betsy R. Durham, RN, A.R.I.T.; Stanley K. Engle, B.S., A.R.I.T.; and David A. Varner, AAS

Respiratory therapy is one of the newest and fastest growing allied health specialities in the United States today, due to the increasing incidence of respiratory diseases in our society and the increasing complexity of the various modalities used in the treatment and diagnosis of these diseases. The respiratory therapist must be an expert in the therapeutic uses of such aids to the breathing process as medical gases, oxygen administering apparatus, humidity and aerosol devices, positive pressure ventilation, mechanical airways, and cardiopulmonary resuscitation. In September, 1970, the Duke University Medical Center and Durham Technical Institute initiated an associate degree program in respiratory therapy under the medical direction of the Department of Anesthesiology. It is accredited by the Council on Medical Education of the American Medical Association and approved by the North Carolina State Board of Education. At the completion of this program the student will be awarded the Associate in Applied Science degree and be qualified to participate in the national registry examination.

Program of Study. Of the twenty-one months (7 quarters) needed to complete this program the first nine months (3 quarters) are spent at Durham Technical Institute studying introductory material. The remainder of the time is divided between clinical rotations at Duke and electives at Durham Technical Institute.

Prerequisites for Admission. All applicants must have a high school diploma or its equivalent, including two units of mathematics and two of physical science.





Application Procedures. Applications must be submitted by April 15 of the year for which admission is requested and must contain the following:

1. A completed application form;
2. Official transcripts from all high schools and colleges attended;
3. Placement examinations for Durham Institute given at the time of enrollment;
4. Three letters of recommendation; and
5. A personal interview is requested.

All applicants will be notified by May 15 regarding admission to the program. Requests for further information and application forms should be directed to: Education Coordinator, Respiratory Therapy Program, Box 3094, Duke University Medical Center, Durham, North Carolina 27710.

Registration Fees and Expenses. Durham Technical Institute tuition is \$32 per quarter for in-state students for a total of \$224 for the program. For out-of-state students, the tuition is \$137.50 per quarter or approximately \$962.50 for the program. In addition, books will average \$50 per quarter.

Financial Aid. A limited amount of financial assistance is available to students. More information can be found in the catalogue of Durham Technical Institute.

Courses of Instruction. Students must complete the following:

First Quarter

Title	Location	Quarter Hours Credit
English	DTI	3
Mathematics	DTI	5
General Biology	DTI	4
Chemistry	DTI	5
Introduction to Physics and Technology	DTI	3
Blueprint Reading and Sketching	DTI	1
Introduction to Respiratory Therapy	DTI	2

Second Quarter

Nursing Arts	DTI	3
General Physics I	DTI	4
Anatomy and Physiology	Duke	4
Composition	DTI	3
Respiratory Therapy Procedures	DTI	6

Third Quarter

Cardiopulmonary Anatomy and Physiology	Duke	4
Respiratory Therapy Procedures	DTI	9
Pharmacology	DTI	3
Oral Communication	DTI	3
General Physics II	DTI	4

Fourth Quarter

Report Writing	DTI	3
General Physics III	DTI	4
Microbiology and Pathology	Duke	4
Respiratory Therapy Procedures	Duke	9

Fifth Quarter

Electives	DTI	3
Respiratory Therapy Procedures	Duke	10
Applied Psychology	DTI	3

Sixth Quarter

Respiratory Therapy Procedures	Duke	16
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Seventh Quarter

Respiratory Therapy Clinical Application	Duke	15
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Courses of Instruction

Medical Technology

CHS 151. Medical Applications of Computers. This lecture, laboratory, and demonstration course will introduce the student to computer use for calculational and non-numeric computation through use of a higher order language (e.g., FORTRAN), and to the uses of computers in ongoing medical and medicine-related projects in the Duke-Veterans Hospital complex. The practical assignments, in conjunction with lectures and demonstrations, will permit the students, as part of the course, to write, evaluate or analyze a problem-directed program. One course. Dorsey, Henderson, and Staff

PHS 180. Basic Human Physiology. A lecture-demonstration course in which the functions of major organ and tissue systems and their contributions to total body homeostasis in health and disease are discussed. The interpretation of laboratory findings in view of known physiological parameters and the communication, using appropriate terminology, of these findings to physicians and other health care professionals as well as to the patient and his family is stressed. One course. Carter, Rosenthal, and McHale

PTH 103. Introduction to Laboratory Technique and Basic Physical Principles. Principles of microscopy, colorimetry, analytical measurements, and spectrophotometry are presented. Technical operations such as pipetting, titration, bacteriologic inoculations, aseptic technique, manual hematologic methods, screening, and microscopic examination of body fluids are learned. Discussion and lectures are concerned with physiologic derangements best examined by these techniques. Statistical analysis of laboratory data and applicability of quality control programs are included. One course. Widmann, Spooner, and Zwadyk

PTH 107. Human Pathology. The course deals with human structure and function, with correlation of anatomy, microanatomy, and the purposes served in achieving growth and maintaining homeostasis. Changes that occur in general categories of disease (trauma, infection, neoplasia, degeneration, congenital defects, etc.) and the anatomical, microanatomical, and biochemical ways in which these derangements become apparent are discussed. One course. Widmann and Staff

PTH 202. Instrumentation. Principles of major types of advanced laboratory instruments: continuous flow and analysis, electronic particle counting, thin-layer and gas chromatography, scintillation counting, specific instruments such as GEMSAEC, Automated Chemical Analyzer, etc. are discussed. The student will acquire sufficient understanding of operating principles so that he can provide normal maintenance and first-level repair on major types of laboratory instruments, and can apply theoretical principles to the development of new methodologies for these machines. One course. Spooner, Habig, and Staff

PTH 204. Medical Chemistry. The course deals with the following topics: the biochemistry of disease, with emphasis on diagnostic tests; statistical methods as applied to the study of normal populations, abnormal populations, and the individual patient; pitfalls in diagnostic biochemistry and the influence of multiple variables; evaluation of test methods in terms of technical requirements, cost, accuracy, etc. One course. Spooner, Habig, Bittikofer, and Staff

PTH 210. Immunology and Immunohematology. Presentation of the immune response, both cellular and humoral, and the primary and secondary diseases which affect these systems. Other topics include: the diagnostic and therapeutic implications of bacterial, fungal, and viral antibodies; the antigen of red blood cells, white blood cells, and other tissue sites, and the spontaneously occurring and acquired antibodies to them; collection, processing, and storage of blood for transfusion purposes. One course. Widmann and Zwadyk

PTH 211. Blood and Body Fluids. This course will discuss both primary and secondary hematologic diseases, with consideration of clinical and laboratory techniques for diagnosing disorders of red blood cells, white blood cells, platelets, hemostatic mechanisms, and blood volume. The section on body fluids will include physiologic alterations and laboratory findings related to urine, cerebrospinal fluid, joint fluid, effusions, and feces. One course. Widmann and Schmidt

PTH 212. Parasitology. Lecture and correlative student laboratory sessions present information on epidemiology, life cycles, and identification procedures for the more common animal parasites which infect man. One-half course. Bumgarner

PTH 224. Educational Techniques for the Health Professional. The course is designed to prepare the student to communicate technical and theoretical material to peers, to students at the post high school level and above, and to other health professionals. Topics include the construction of tests at various levels, methods to evaluate effectiveness of communication in situations less structured than formal examinations, and the use of audiovisual equipment and construction of effective visual aids for information transmission. One-half course. Boeck and Staff

PTH 226. Laboratory Supervision and Management. Principles of group supervision, with consideration of work patterns, laboratory design, laboratory staffing, personnel relations, equipment evaluation, and procurement are pre-



sented. Review of federal regulations affecting laboratories, personnel, hospitals, etc. is included. One-half course. Britt and Staff

PTH 232. Medical Microbiology. Introduction to the morphology and physiologic activities of bacteria and medically significant fungi, as well as functional aspects of viruses. Extensive consideration is given to microorganisms in the etiology of disease; the interaction of host and invader; the epidemiology of nosocomial infections; and the mechanisms of antimicrobial therapeutic agents. The laboratory sessions will develop beginning expertise in isolating and identifying commonly pathogenic organisms, and in the techniques required for bacterial and fungal propagation, anti-bacterial susceptibility assays, and environmental surveillance. One course. Osterhout, Zwadyk, Proctor, and Britt

PTH 299. Student Seminar. Topics in medical laboratory science presented by the student to his peers and medical technology faculty. Topic selection to be approved by the faculty. One-half course. Britt, Schmidt, and Staff

CLINICAL LABORATORY COURSES: PATHOLOGY, MEDICINE, BIOCHEMISTRY, AND MICROBIOLOGY STAFF

PTH 206. Clinical Microbiology. Ten weeks of clinical training in diagnostic microbiology laboratories of the Duke and VA Hospitals. One-half course.

PTH 208. Immunology-Serology. Eight weeks of experience is given in techniques and applications of principles in immunohematology and serology. One-half course.

PTH 209. Blood and Body Fluids. Nine weeks of clinical practice in the study of blood elements and body fluids. Expertise in recognizing pathologic conditions is gained. One-half course.

PTH 231. Clinical Chemistry. Ten weeks of clinical course work in the laboratories of the Duke and VA Hospitals. One-half course.

Pathology Assistant

ANA 207. Human Anatomy. A lecture-laboratory discussion course that examines human morphology and the fundamental relationships among the neurologic, musculo-skeletal, cardiovascular, gastrointestinal, respiratory, renal, and reproductive systems. The course includes cadaveric presentations of every major region of the human body. Intended primarily for students in allied health programs. One course. *Blake and Staff*

MIC 106. Introductory Microbiology. An introduction to diagnostic microbiology covering such topics as microbial morphology, staining characteristics, growth requirements, diagnostic tests, and antibiotic susceptibility testing. The clinical aspects of such subjects as pyogenic cocci, gram negative sepsis and nosocomial infection, meningitis, venereal disease, enteric infection, anaerobic pathogens, tuberculosis, mycotic diseases, viral infections, and the use of antibiotics are also included. One-half course. *Osterhout*

PHS 180. Basic Human Physiology. A lecture-demonstration course in which the functions of major organ and tissue systems and their contributions to total body homeostasis in health and disease are discussed. The interpretation of laboratory findings in view of known physiological parameters and the communication, using appropriate terminology, of these findings to physicians and other health care professionals as well as to the patient and his family is stressed. One course. *Carter, Rosenthal, and McHale*

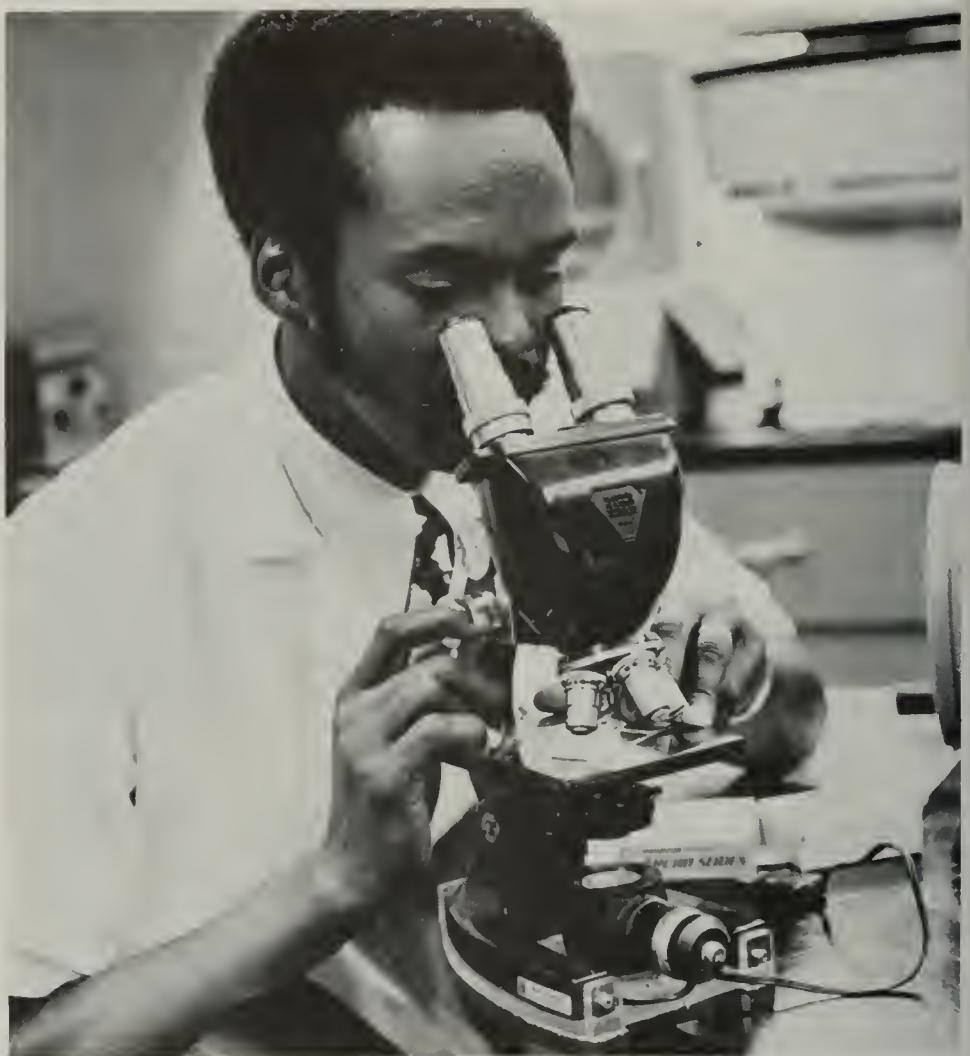
PTH 102. Histopathological Technique. The student is presented a wide background of knowledge in tissue and cell morphology and physiology. Emphasis is placed on cellular and subcellular structures which help develop tissue types. A synthesis of current concepts of ultrastructure is related to those of light microscopy. Students learn to evaluate and interpret, under light microscopy, those features which distinguish one tissue from another. The interrelationship between cytology, histology, and organology is stressed. One course. *Broda*

PTH 103. Introduction to Laboratory Technique and Basic Physical Principles. Principles of microscopy, colorimetry, analytical measurements and spectrophotometry are presented. Technical operations such as pipetting, titration, bacteriologic inoculations, aseptic technique, manual hematologic methods, screening, and microscopic examination of body fluids are learned.



Discussion and lectures are concerned with physiologic derangements best examined by these techniques. Statistical analysis of laboratory data and applicability of quality control programs are included. One course. Widmann, Spooner, and Zwadyk

PTH 105. Basic Hematology. Basic knowledge in human blood cell morphology is gained via lectures and laboratories. Students study normal hematopoietic maturation and are also introduced to those states of maturation which are recognized as being pathological. The approach is a morphological one with less emphasis on clinicopathological correlation. One-half course. Wells and Staff



PTH 106. Basic Pathology. Basic principles which will enable the student to develop an ability to analyze disease are presented. These main principles include the study of circulatory disturbances; degenerative processes; infiltrations and metabolic disorders; disturbances of development and growth; the inflammatory process, including etiologic and pathogenic considerations; regeneration and repair; and neoplasia. Lectures and discussions within these categories will be presented by the faculty as well as by the student. Seminar papers discussing and interpreting the classical papers leading to the main theories of disease etiology and pathogenesis will be presented by the student. One-half course. *Broda*

PTH 110. Systemic Pathology. Disease processes are studied via methods and techniques utilized in organ system dissection as they pertain to autopsy pathology specimens. Clinicopathologic correlation is stressed utilizing gross and microscopic examples of disease processes, case studies, lectures, and demonstrations. One course. *Staff*

PTH 200. Pathology. Fundamentals of pathology are presented by correlating gross and microscopic material to illustrate the structural changes in disease. Lectures consisting of broad concepts of disease processes are presented by senior faculty and conferences with small groups of students are held under the guidance of staff members. Etiology and pathogenesis of disease as well as the experimental approach are emphasized for the purpose of correlation with clinical disease. In addition to group work, conferences are scheduled to discuss problems derived from autopsies. Students are required to collaborate in postmortem studies and present cases in clinical-pathologic conferences under the direction of the staff. Two courses. Staff

PTH 205. Autopsy Technology. During this six week on-the-job training period, the student is introduced to autopsy dissection techniques and general anatomical pathology protocol. He learns various dissection techniques and the proper procedure for completing autopsy cases. These include evisceration, organ block dissection, tissue preparation for histology, microscopic evaluation, and final protocol completion. One and one-half course. Staff

PTH 207. Medical Photographic Technology. This six-week course offers the student, via lecture and practical assignments, basic photographic theory and principles including lighting, optics, photo-chemistry, camera handling techniques, color film selection, exposure determinations, and film processing as applied to pathology. The student will be given the opportunity to become proficient in such technical aspects as developing and preparation of developing materials, printing of photographs, lighting and background techniques, photographing of specimens, both *in situ* and in display, and photo-micrography. One and one-half course. Veterans Administration Hospital Medical Illustration Department



PTH 213. Histologic Technology. During the four week rotation in histology the student is presented the knowledge necessary for the preparation of tissue slides. Following this he is taught the basic principles of tissue processing, which include: fixation, decalcification, hand and automatic processing, blocking, embedding, cutting and staining, specific staining and histochemical procedures, cryostat and other frozen section methods, tissue manicuring for processing, and certain electron microscopic and cytologic techniques. One course. *Histology Staff*

PTH 220. Forensic Pathology. Selected students who demonstrate a distinct interest and aptitude in forensic medicine are allowed to take an elective rotation in the State Medical Examiner's System during which time they are introduced to the intricacies and variations of legal medicine. One course. *Hudson*

PTH 230. Clinical Diagnostic Methods. The course is designed to instruct the student in technical and clinical laboratory procedures which are utilized in the diagnosis of disease. Emphasis is placed upon selection and interpretation, rather than the performance of the various procedures. One course. *Staff*

PTH 237. Surgical Pathology. Students are instructed in gross and microscopic pathology as it pertains to surgical specimens. Gross and microscopic findings are correlated with clinical observations while the student learns the proper procedural handling of selected specimens. Problems in dermatology, gynecology, orthopaedics, general surgery, internal medicine, and other specialties will be considered. The program of study will consist of lectures, demonstrations, and laboratory work. One course. *Staff*

PTH 298. Department of Pathology Elective Courses. Qualified students who have demonstrated interest in specialized areas of pathology e.g., pediatric pathology, renal pathology, cytopathology, etc. are allowed to participate in these courses as they are offered in the department. One course. *Staff*

Physician's Associate

BASIC SCIENCE COURSES

ANA 207. Human Anatomy. A lecture-laboratory discussion course that examines human morphology and the fundamental relationships among the neurologic, musculo-skeletal, cardiovascular, gastrointestinal, respiratory, renal, and reproductive systems. The course includes cadaveric presentations of every major region of the human body. Intended primarily for students in allied health programs. One course. *Blake and Staff*

CHS 270. Community Health Sciences. A description of the development of key ideas concerning modern scientific medicine and broad social questions regarding the medical profession. Topics include: the social roles of patients as well as physicians, the public image of medicine, the impact of various historical epochs such as the industrial revolution, and changing attitudes toward poverty and welfare. The various systems for the delivery of health care, the nature and implications of pending health care legislation, health care cost and payment mechanisms, and types and extent of health care services, provided by both public and private agencies are examined. In addition, there will be discussions of the social and cultural aspects of

health, dealing with the terminally ill, euthanasia, genetic engineering, and human subject experimentation. Epidemiology and statistical principles will also be included. Boeck, Brieger, and Staff

MED 110-111. Clinical Medicine. A classroom lecture course taken concurrently with Patient Evaluation (MED 120-121). The major problems with which patients present and the use of a data base (historical information, physical examination, laboratory parameters) relating to these problems enabling the student to extract a problem list are discussed. Detailed information about the more important aspects of disease states prevalent in the United States causing the demand for health service and the characteristics of both the normal and abnormal disease states are examined. Students learn to communicate their findings to physicians, nurses, and other health personnel using the appropriate terminology. (Enrollment limited to physician's associate and nursing students.) Four courses. Skyler and Staff

MED 120-121. Patient Evaluation. Students meet in groups of four with one instructor for bedside experience in the techniques of obtaining meaningful health histories and performing thorough physical examinations. Students are taught to record patient data using the format of a problem oriented medical record and then to present such information orally to the supervising physician. (Enrollment is limited to physician's associate and nursing students.) One course. Skyler and Staff

MED 240. Human Interaction. The development of problem lists and how to use them as tools in furthering one's own education process are explained. The advanced aspects of patient interviewing are also discussed. One-half course. Neelon

MIC 106. Introductory Microbiology. An introduction to diagnostic microbiology covering such topics as microbial morphology, staining characteristics, growth requirements, diagnostic tests, and antibiotic susceptibility testing. The clinical aspects of such subjects as pyogenic cocci, gram negative sepsis and nosocomial infection, meningitis, venereal disease, enteric infection, anaerobic pathogens, tuberculosis, mycotic diseases, viral infections, and the use of antibiotics are also included. One-half course. Osterhout

PHS 104. Introductory Pharmacology. A lecture-seminar course developed to acquaint the student with the relationship between drugs and living systems. Chemotherapeutic agents are classified and studied in groups with the emphasis placed on understanding the functions and characteristics of commonly used prescription drugs. One course. Rosen and Staff

PHS 180. Basic Human Physiology. A lecture-demonstration course in which the functions of major organ and tissue systems and their contributions to total body homeostasis in health and disease are discussed. The interpretation of laboratory findings in view of known physiological parameters and the communication, using appropriate terminology, of these findings to physicians and other health care professionals as well as to the patient and his family is stressed. One course. Carter, Rosenthal, and McHale

PTH 101. Basic Clinical Chemistry. An introduction to physiological chemistry including normal human metabolism and its control and the alterations of normal metabolism induced by disease or stress. Students are taught to correlate laboratory findings with the cellular metabolic events taking place and to communicate the normal and abnormal phenomena to physicians, nurses, and other health personnel using appropriate terminology, and to explain com-

mon situations to patients. By studying the metabolic control and disease alterations, the student is able to suggest appropriate measures to further delineate the problem and to provide a therapeutic approach. One course. Spooner and Staff

PTH 103. Introduction to Laboratory Technique and Basic Physical Principles. Principles of microscopy, colorimetry, analytical measurements, and spectrophotometry are presented. Technical operations such as pipetting, titration, bacteriologic inoculations, aseptic technique, manual hematologic methods, screening, and microscopic examination of body fluids are learned. Discussion and lectures are concerned with physiologic derangements best examined by these techniques. Statistical analysis of laboratory data and applicability of quality control programs are included. One course. Widmann, Spooner, and Zwadyk

PTH 107. Human Pathology. The course deals with human structure and function, with correlation of anatomy, microanatomy, and the purpose served in achieving growth and maintaining homeostasis. Changes that occur in general categories of disease (trauma, infection, neoplasia, degeneration, congenital defects, etc.) and the anatomical, microanatomical, and biochemical ways in which these derangements become apparent are discussed. One course. Widmann and Staff

RAD 108. Introductory Radiology. A review of roentgen anatomy and an introduction to the uses of radiology in the care of patients. Students learn the basic clinical concepts and develop skills in performing basic scanning and routine radiographs. One-half course. Thompson

SUR/MED 109. Experimental Surgery/Electrocardiography. An introduction to basic surgical principles and techniques and the fundamentals of aseptic technique needed in the preparation of the operative site and draping of the sterile field. Students learn the basic principles of pre- and post-operative management for the purpose of developing knowledge of the organism's management. The principles of electrocardiography, the characteristics of electrocardiograms, and the necessity of correlating laboratory data with patient behavior are also presented. One course. Dixon, Toth, Surgical Staff, and Cardiology Staff

CLINICAL ROTATIONS

CHS 150. General Community Medicine. An eight-week rotation in which the student learns to compile a data base about common office and hospital problems facing community practitioners and maintain problem-oriented medical records while aiding the physician in the evaluation and care of the patient. One course. Staff

CHS 151. Family Practice. An eight-week clinical experience surveying the components of family practice, including emotional conflicts and interpersonal relationships with the patient and other members of the family unit. Through experience in interviewing and examining patients, the student is exposed to the multifaceted approach of understanding and treating physiologic and sociologic components of disease processes. In this situation, an understanding of the common diseases treated by primary care practitioners and the aspects of the unique relationship a physician's associate experiences with private patients, their physician, and other health team members is developed. One course. Staff



CHS 152. Rehabilitation. An eight-week rotation studying the treatment of limitations caused by disease and injury. The student receives training in patient rehabilitation through participation in both inpatient and outpatient physical and occupational therapy services and weekly medical-surgical-rehabilitation conferences. Instruction is oriented toward the early return to work of disabled employees and matching physical capabilities with job demands. One course. *Roberts and Rehabilitation Staff*

CHS 153. Introduction to Occupational Medicine. During this eight-week rotation the student studies the field of occupational medicine including its history, particularly in the United States; legislation dealing with the protection of workers, including Workmen's Compensation; types of occupational health hazards; industrial toxicology and occupational diseases; and in-plant medical programs. Seminars, reading, case studies, and field work will be required. One course. *Goldwater*

CHS 155. Independent Study. This special course enables students, on an individual basis, to select with program administrators a series of objectives and to develop a program that can reasonably be expected to achieve those objectives. One course. Estes, Skyler, and Staff

CHS 190. Family Medicine. This forty-eight week elective option is a substitute for the usual curriculum. The student is assigned to one senior family practice resident and rotates with that resident throughout the year, in both hospital and ambulatory settings, thus gaining throughout the year, in both hospital and ambulatory settings, thus gaining a broad exposure to a variety of types of problems while developing a close relationship with an individual physician. The experience gained is similar to having taken courses in general community medicine, family practice, inpatient medicine, and outpatient medicine. Six courses. Jordan and Staff

CHS 199. Primary Care Medicine. An eight-week clinical experience in association with a community-based practitioner to acquaint the student with those aspects of the practice of medicine unique to the community setting. In the hospital the student makes rounds with the physician and assists him in fulfilling his inpatient responsibilities. In the office, the student learns about management procedures in a private practice and helps the physician by providing services consonant with his individual background and clinical training. This is a non-credit course but is required for certification as a physician's associate. No credit. Estes, Skyler, and Staff

MED 150. Inpatient Medicine. An eight-week full-time required clinical rotation in which the student learns to apply his basic medical knowledge to the problems and situations encountered on an inpatient service. By collecting a data base formulating a complete problem list, participating in daily rounds, participation in the management of patient problems, the student develops an awareness and understanding of the multiple aspects of disease processes and becomes familiar with therapeutic regimen and dispositions relative to specific disease states. The student will present the data base of each new patient to the supervising physician or attending rounding physician in a coherent, concise fashion. One course. Staff

MED 151. Outpatient Medicine. An eight-week full-time required clinical rotation in which the student learns to apply his basic medical knowledge to the common problems and situations encountered on an outpatient/emergency service. The student assists the staff by taking histories, completing physical examinations, initiating emergency care consistent with triage findings reviewed by the resident staff, performing routine diagnostic laboratory studies, and arranging for and tabulating data from other diagnostic studies. One course. Staff

MED 152. Intensive Care. A four-week rotation that acquaints the student with the acute and intensive care required for patients who have undergone major and complex surgical procedures, suffered massive and severe trauma involving multiple organ systems, or experienced sudden complicating cardiorespiratory collapse or other life threatening medical crises. Emphasis is placed on ventilatory assistance, cardiopulmonary resuscitation, fluid and electrolyte replacement, and acid-base balance under resident physician supervision. One-half course. Staff

MED 153. Cardiology. A four or eight week rotation during which the indication, limitations, and methods of performing necessary diagnostic proce-

dures for the evaluation of disorders of the cardiovascular systems are studied. Students conduct initial patient evaluations including the history and physical examination and perform relevant diagnostic and therapeutic studies including familiarity with electrocardiographic and phonocardiogram studies. One-half or one course. *Cardiology Staff*

MED 154. Cardiovascular Laboratory. During this four or eight week rotation the student studies the physiology and pathophysiology of common acquired and congenital heart diseases. Patients' histories, physical examinations, and laboratory findings are correlated with the hemodynamic and angiographic findings obtained during cardiac catheterization. The student learns the indications, usefulness, and possible complications of different cardiac catheterization and other diagnostic procedures and develops skill to assist the physician in performing them. In addition one learns the general setup of a cardiac catheterization laboratory and to develop skills to operate various X-ray and electronic equipment used in cardiac catheterization. One-half or one course. *Cardiology Staff*

MED 155. Endocrinology. A four or eight week rotation designed to acquaint the student with endocrinological diseases with an emphasis placed on obtaining the defined endocrine data base and appropriate treatment of the disease. Students attend all daily rounds and conferences while on the service. They are taught the indications, limitations, and methods of performing diagnostic procedures including: glucose, tolbutamide, and arginine tolerance tests; thyroid function tests; and urinary steroid determinations. Students educate patients with endocrine diseases about their disease processes, diagnostic evaluations, and therapies. One-half or one course. *Endocrinology Staff*

MED 156. Gastroenterology. During this four or eight week rotation students study the diagnosis, pathophysiology, and essentials of therapy of various gastroenterologic problems. He learns to perform and interpret the following diagnostic procedures; nasogastric intubations and gastric analyses (both with and without fluoroscopy), secretin tests, rectal and small bowel biopsies, proctoscopies, sigmoidoscopies, and gastroscopies. He also learns to care for endoscopic and biopsy instruments and biopsy specimens. One-half or one course. *Gastroenterology Staff*

MED 157. Hematology-Oncology. During this four or eight week rotation the student learns to recognize physical abnormalities, especially those relevant to hematologic and oncologic problems, and to measure and record these on grid sheets; the classical symptomatic expression for some of the most frequent neoplastic disorders; and to recognize and diagnose the most frequent, common anemias. In addition he learns to perform a peripheral blood differential of the white cells; the principles of blood transfusions and steps in the management of untoward reactions to blood; and to assist at procedures such as thoracentesis, paracentesis, bone marrow aspiration, bone marrow biopsy, and spinal lumbar puncture. The proper way to approach patients with serious and life-threatening illness so that history taking and discussion can be meaningful, but not threatening to either the patient or the student is explained. One-half or one course. *Hematology Staff*

MED 158. Hyperbaric Medicine. A four or eight week rotation providing an understanding of the importance and relationship of detailed patient work-ups specifically related to patients requiring the services of the hyperbaric chamber. The indications, limitations, and scope of hyperbaric services; an

understanding of the proper use of the hyperbaric chamber; and the progress of patients under and/or following hyperbaric therapy, including pre- and post-treatment rounds, are covered in this course. One-half or one course. Pulmonary Staff

MED 159. Allergy and Respiratory Disease. A four or eight week rotation that provides an in-depth exposure to patients with respiratory and allergic conditions. The problems encountered by patients who have respiratory ailments are studied in detail as are the associated special history and physical examination techniques and diagnostic and therapeutic procedures (including allergy skin testing, eosinophilic nasal smear counts, sputum evaluation, chest X-ray, and ventilatory therapy). The student participates in daily rounds and teaching conferences on respiratory diseases and gains a knowledge of the therapeutic regimen, their indications, availability, reliability, and limitations in the treatment of respiratory and allergic diseases. One-half or one course. Pulmonary Staff

MED 160. Nephrology. During this four or eight week rotation, the student learns to gather and record information in a problem-oriented manner about patients with renal and hypertensive diseases. He becomes able to recognize the effects of disease, therapy, and education on the patient's course and plays a major role in patient education. The fundamentals of renal function, urinalysis, radiography of the chest, urinary system and bones, and the principle of dialysis are covered. One-half or one course. Nephrology Staff

MED 161. Neurology. A four or eight week rotation dealing with neurological problems through the inpatient and outpatient care and evaluation of neurologic patients including specialized history and physical techniques used in diagnosing neurologic diseases. Performing diagnostic and therapeutic procedures including lumbar punctures, tolerance testings, intravenous infusion of medications, complete blood counts, spinal fluid analyses, and blood cultures are part of this course. Scheduling procedures carried out in radiology, nuclear medicine, and the electroencephalographic laboratory, and assisting in the expedition of patient studies are required during training. The student develops an understanding of neurologic procedures, including electroencephalography, brain scan studies, pneumoencephalography, and central nervous system radiologic dye studies. Discharge physical examinations and recording narrative summaries to ensure chart completion are carried out as directed. The student is required to attend all daily public and private teaching rounds and neurological conferences. One course. Neurology Staff

MED 162. Rheumatology. This four or eight week rotation provides an in-depth exposure to rheumatologic disease. Students learn therapeutic techniques specifically related to rheumatology patients; learn to carry out detailed specialized patient evaluations; learn the handling and care of necessary specimens and equipment; and develop competence in performing diagnostic procedures required in the evaluation and treatment of rheumatologic patients. The scope of the course includes the therapeutic regimen and the indications, availability, reliability, and limitations in the treatment of rheumatologic disease. One-half or one course. Rheumatic and Genetic Diseases Staff

MED 163. Dermatology. During this four-week rotation, the student obtains histories and performs physical examinations on both inpatients and outpatients with special emphasis on problems concerning dermatologic diseases, as well as carrying out potassium hydroxide preparations, skin biops-

sies, and tissue scrapings on prescribed patients. The student becomes familiar with the diagnostic procedures and therapeutic regimen and their indications, availability, reliability, and limitations in the treatment of dermatologic diseases. One-half course. *Tindall and Dermatology Staff*

MED 164. Infectious Disease. A four-week rotation surveying the findings and effects of numerous pathogenic bacteria and fungi as they relate to infectious disease processes. The student learns to plant bacterial cultures; to perform gram-staining techniques; to read culture plates; to set up simple diagnostic procedures; to interpret antibiotic susceptibility tests; and to correlate laboratory findings with the clinical manifestations of infectious diseases. One-half course. *Osterhout and Staff*

MED 165. Clinical Infectious Disease. During this four week rotation, the student learns to approach patients presenting with infectious diseases; to gather a data base from them; and to understand the manifestations of the illnesses and the rationale for therapy. One-half course. *Staff*

MED 199. Internal Medicine. This forty-eight week experience in multiple aspects of internal medicine is substituted for the usual curriculum. The objectives are the same as for the course in inpatient medicine, outpatient medicine, and intensive care. Six courses. *Staff*

OBG 150. Obstetrics/Gynecology. An eight-week clinical experience studying a broad spectrum of obstetrical and gynecological problems. While on the obstetric service, the management of pregnancy, labor, and delivery including antenatal, natal, and postnatal complications is taught. The student is responsible for taking obstetrical histories, performing obstetrical physical examinations, and following patients through labor, delivery, and the early postpartum period. While on the gynecologic service the student is exposed to methods and programs relating to cancer detection, venereal diseases, and birth control. Learning to take gynecologically oriented patient histories and perform complete and accurate gynecologic examinations is required. Attendance at all obstetrical and gynecological teaching rounds, conferences, and seminars is also required. One course. *Staff*

OBG 151. Office Gynecology. A four-week clinical experience reviewing a spectrum of gynecologic processes. The student is exposed to programs relating to cancer detection, venereal disease, and birth control. Learning to take gynecologically oriented patient histories and perform accurate gynecologic examinations is required. While on the rotation the student is familiarized with the principles of office gynecology and participates in daily rounds, teaching conferences, and seminars. One-half course. *Staff*

OPH 150. Ophthalmology. This is an eight-week rotation reviewing the major ophthalmologic diseases. Through lectures, teaching rounds, and learning special history and physical examination techniques, the student develops an expertise in determining visual fields, visual acuity, and oculotonometry. The principles of refraction and the many medical and surgical therapeutic regimens available for treating ophthalmologic disorders are included. The student is also required to participate in the routine care of ophthalmologic inpatients and outpatients. One course. *Staff*

PED 150. General Pediatrics. The major objective of this four or eight week course is to provide the student an overview of pediatric practice with emphasis on the well child and his health supervision. The student is exposed to childhood illnesses and normal variations of growth and development.

Besides learning to take third party histories and perform pediatric physical examinations, the student observes and participates in the activities of the intensive care nursery, and learns specific techniques used in the care of the immature and newborn. One-half or one course. Pounds and Staff

PED 151. Pediatrics Outpatient. During this four or eight week rotation the student gains an appreciation of the preventive medicine basis of all of pediatrics. He learns to assess children with minor illnesses, order appropriate studies, instruct the mother in reasonable home care, and to call to the physician's attention complications of minor illnesses. He gains an overall appreciation of the subspecialties of pediatrics; gains experience in proper record keeping on outpatients, and of the importance of updating all problems on each visit; he is able to recognize the acutely ill child who requires the immediate attention of the physician. One-half or one course. Pounds and Staff

PED 152. Intensive Care. A four-week rotation that acquaints the student with the acute and intensive care required for patients who have undergone major and complex surgical procedures, suffered massive and severe trauma involving multiple organ systems or experienced sudden complicating cardiorespiratory collapse or other life threatening medical crises. Emphasis is placed on ventilatory assistance, cardiopulmonary resuscitation, fluid and electrolyte replacement, and acid-base balance under resident physician supervision. One-half course. Staff

PED 153. Pediatric Chest and Allergy. During this four or eight week rotation the student is taught to obtain a complete history and physical examination with emphasis on the allergy data base and the structure of the family. He gains an understanding of the impact of chronic illness on the child and his family. He gains an understanding of home care programs and is able to alter them to fit a family's ability and resources. He is able to carry out appropriate diagnostic procedures and assess the results for children with pulmonary disease. One-half or one course. Staff

PED 154. Full Term Nursery. During this four or eight week rotation the student learns to collect the maternal history accurately and completely as it pertains to the product of current pregnancy; to recognize those maternal conditions imposing risks on the full term infant; to collect samples for newborn screening laboratory exams; to examine a full term infant and distinguish those who are abnormal from those who are normal; and to give cogent instructions to mothers regarding home care of the infant. One-half or one course. Staff

PED 155. Clinical Research Unit. A four or eight week rotation covering diversified pediatric inpatient problems. The student develops proficiency in a variety of clinical procedures used in evaluating complex pediatric conditions. Attendance at all daily teaching rounds is required as well as carrying out diagnostic studies as instructed by the attending physician including: routine laboratory analyses, tolerance testing (intravenous glucose, insulin, and tolbutamide studies), intravenous catheterizations, venous cutdowns, nasogastric intubations, and gastric analyses. The student is responsible for eliciting, recording, and reporting clinical and laboratory data and expanding the ability to correlate clinical signs and symptoms with laboratory data. One-half or one course. Sidbury and Clinical Research Unit Investigators

SUR 150. General Surgery. An eight-week rotation that exposes the student to a great variety of clinical problems, crossing, at times, many so-called specialty lines. Emphasis on the gastrointestinal tract, general trauma, endo-



crine tumors, peripheral vascular reconstructions, congenital and pediatric surgical problems are inherent in this rotation. Basic surgical principles, as well as insights into many of the surgical specialties, can be learned on this service. Preoperative diagnostic principles and postoperative management rationale are emphasized. An attractive feature of the rotation is the great diversity of surgical problems encountered. Each student is provided an opportunity to gain facility in patient care through management of patients with par-

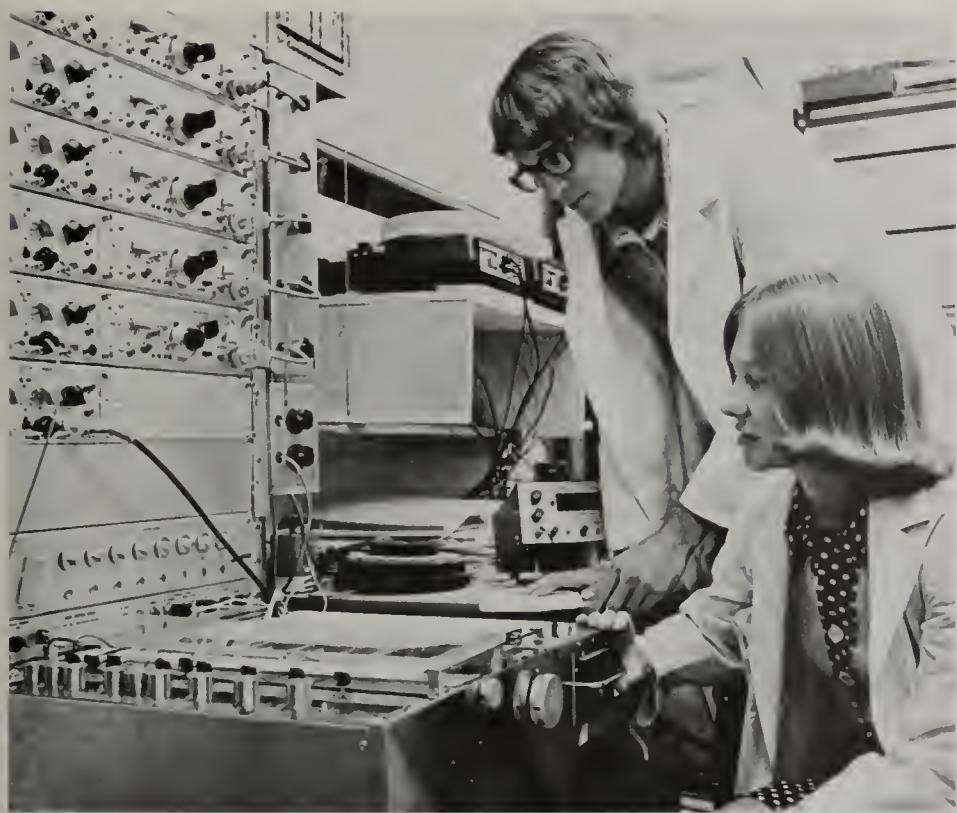
ticular problems. The student is encouraged to use his previous training and knowledge of disease to grasp how clinical diagnostic and care problems are managed, both in the operating room and on the ward. One course. Staff

SUR 151. Surgical Outpatient/Emergency. During this rotation the student is provided contact with a large number of ambulatory patients in order to provide experience and familiarity with the screening procedures and methods used to diagnose and treat ambulatory outpatients. He gains additional experience in history taking and physical examinations in an abbreviated manner, consistent with intensive care visits; evaluates the return patient and observes his clinical course over a period of time and gains confidence and facility in the necessary laboratory and diagnostic procedures required to manage patients in this setting. A familiarity with problems in the administration of the small surgical unit and in treating indigent patients is developed. Two courses. General and Thoracic Surgery Staff

SUR 152. Intensive Care. During this experience the student learns to recognize patients requiring intensive medical care; operates and maintains life-monitoring equipment, understands and evaluates fluid electrolyte replacement and acid base balance; and gains experience in cardiopulmonary resuscitation and ventilatory assistance. This experience may be gained on the respiratory care unit, medical care unit, intensive care nursery, surgical acute care unit, and pulmonary function-inhalation therapy. One-half course. Staff

SUR 153. Cardiothoracic Surgery. During this rotation, the student learns to perform a detailed history and physical examination with special emphasis on the cardiothoracic system. Through previous classroom and laboratory experience, the student should be able to gather and interpret standard laboratory data such as chest X-ray, WBC, and screening chemical profile. With special help from the resident and senior staff and through reading on his own, the student should be able to interpret special diagnostic procedures such as angiograms, pulmonary function studies, etc. In the operating room, the student will assist and follow the conduct of various open-heart and other major thoracic





procedures. The resident, senior staff, and student will participate in the management of sophisticated procedures such as various arrhythmias, shock, fluid and electrolyte imbalance, as well as the more common procedures such as the insertion of chest tubes and intrapleural drainage procedures. One course. *Cardiothoracic Staff*

SUR 154. Cardio Pulmonary By-Pass. This course is offered to only those students who plan to be employed by a cardiothoracic surgeon. The objective of this course is to observe and assist in the operation of the cardiopulmonary by-pass machine. This course is not intended to make a student a by-pass technician, but rather to familiarize the student with the complexity of its operation and management. One-half course. *Cardiothoracic Division and By-Pass Staff*

SUR 155. Surgical Acute Care Unit. During this rotation, the student is acquainted with the post-operative care of patients who have undergone surgical procedures or suffered massive and severe trauma involving multiple organ systems. Special emphasis is centered on ventilatory assistance problems, open heart cases, neurosurgical problems, and massive trauma cases. Those patients developing intra-operative complications requiring more than the usual short term recovery care level are also cared for on the ACU. The variety of the patients and the diversity of the problems that exist on the unit gives the student a wide range of insight into surgical post-operative management. The student should strive for an understanding of the pathophysiology, physiology, and the management of surgical post-operative patients in this setting. One course. *Cardiothoracic Division Staff*

SUR 156. Otolaryngology. An eight-week clinical experience studying common otolaryngologic diseases. The student develops an understanding of emergency problems and how to initiate the first steps in the management of such problems. Evaluation of the otorhinolaryngologic patient by appropriate history and physical examination, following the course of disease processes and evaluating the response to treatment by the physician are required. Learning and performing tracheostomy care, assisting with the management of the pre- and post-operative patients, assisting in the operating room, and learning to perform specialized audiometric tests are also required. One-half course. *Otolaryngology Division and Staff*

SUR 157. Plastic Surgery. An eight-week experience studying maxillofacial cancer patients and patients with facial anomalies. There is extensive exposure to patients with burns of electrical, chemical, and thermal origin. The course objectives include an understanding of the pre-operative and post-operative care of plastic surgery patients, recording the pre-operative history and physical examination, performing indicated laboratory tests, and scheduling associated studies. Monitoring the post-operative development and assisting in the care of the post-operative patient in the plastic surgery dressing room is required. The student develops a working understanding of fluid and electrolyte balance and administers intravenous therapy. One course. *Plastic Surgery Division and Staff*

SUR 158. Plastic Surgery Dressing Room. A four-week experience with extensive exposure to the spectrum of congenital disease, cancer, and trauma treated by the plastic surgery service. The student actively participates in the preparation, debridement, and dressing of wounds; planning and following the patient's post-operative course; and recording the physical findings, progress, and prognosis in the patient's chart. All teaching rounds and conferences are required while on the service. One-half course. *Division of Plastic Surgery*

SUR 159. Surgical Anatomy. During this rotation the student is provided the opportunity to familiarize himself and to review the anatomy that will be most helpful during his clinical orthopaedic rotations. He works at his own pace on an orthopaedic problem under the direction of the physician in charge utilizing the teaching aids in the Department of Anatomy and also the medical library when appropriate. One-half course.

SUR 160. Urology. An eight-week rotation that studies urologic disease processes. Performing history and physical examinations on clinic and hospitalized patients is included. Participation in all clinical rounds and teaching conferences is required to develop an understanding of the therapeutic regimen, their indications, availability, reliability, and limitations in the treatment of urologic disorders. The student develops an understanding of urologic disorders and the indications for catheterization, cystoscopy, renal function studies, intravenous pyelograms, and urine chemical evaluations. Participation in the pre- and post-operative care of the urologic patient, performing discharge physical examinations, and writing narrative summaries for assigned patients is part of the course. One course. *Division of Urology*

SUR 161. Neurosurgery. During this eight-week rotation the student is provided with a working understanding of the problems unique in the diagnosis, treatment, and management of the neurosurgical patient. The student may gain experience in the operating room by assisting with the patient, with instrumentation, and with the operative procedure. He gains a working knowledge of



diagnostic techniques such as carotid arteriograms, electroencephalograms, ventriculograms, spinal taps, etc. Opportunities for helping in the management of neurosurgical cases, especially in the Acute Care Unit and on the Neurosurgical Special Care Unit, with special attention to respiratory care of the neurosurgery patient are provided. Observation of Neurosurgery Clinic functions provides exposure to the procedures necessary for assessment of new patients and follow-up patients. Experience and knowledge in emergency room techniques and management of acute neurosurgical injuries (GSW, blunt head trauma, acute quadriplegia, hemiplegia, etc.) is included. One course. Division of Neurosurgery

SUR 163. Orthopaedic Surgery. An eight-week rotation surveying the knowledge necessary for understanding the many problems of the orthopaedic patient. This experience includes learning the complete history and physical examination of the orthopaedic patient; emergency care of those with acute trauma; pre- and post-operative care of the surgical patient; ability to apply different types of traction; ability to understand the mechanism for applying types of traction; ability to apply splints and casts; fabrication of upper extremity splints; and acquiring a background of good sterile and operating room technique. One course. Orthopaedic Division

Health Administration

HA 301. The Health System and Its Environment. An introduction to the organization and management of health services from a systems perspective. Emphasis is on the evolution of the present system and on the interplay of forces within the system and between the system and its environment. 3 units.

HA 312. Comparative Health Systems. A comparative examination of the structure and performance of the health systems of the United States and other countries, particularly Canada and Great Britain. Topics include current financing, capitalization, utilization, control, and the relative roles of the governmental and private sectors. 3 units.

HA 322. Public Policy and Health Care. A study of the development and present status of selected public policy issues within their social, economic, and political contexts. Alternative courses of possible public action are reviewed and their probable outcomes are assessed. 3 units.

HA 324. Institutional Health Services. A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other long-term care institutions. Specific study is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; the planning function; and the evaluation of performance. 6 units.

HA 329-339-349. The Practicum. The practicum is designed to provide the student an opportunity to experience and develop perspective on the interplay of various forces and problems within the field of health services delivery. Each student rotates through six different settings that are selected as focal points for significant combinations of people, problems, and resources. Within each setting the student, under faculty supervision, is responsible for the con-





duct of certain administrative functions in order to increase his ability to solve real problems and improve personal judgment. 2 units each in the summer, fall, and spring semesters.

HA 335. Ambulatory Health Services. This course covers the noninstitutional components of the organization and provision of personal health services. The principal emphasis is on medical group management, including forms or organization, financing of services, physician-patient relationships, medical records, and peer review. Other topics examined include dental care, home care, half-way houses, multiphasic screening, and community health and mental health centers. 3 units.

HA 346. Community Health Services. The focus of this course is the organization and management of health services directed toward general populations rather than individuals. Coverage includes aspects of environmental and occupational hygiene, nutrition and housing, planning community health services, preventive health education programs, and other public health activities. Included are the problems associated with health status measurement and assessment. 3 units.

HA 348. Legal and Regulatory Constraints on Health Services. This course treats the legal relationships between elements of the health system and the larger society of which it is a part. Attention is devoted to the certification, operation and performance of health manpower, organizations and services, and the difficulties in establishing effective restraints to minimize undesired results. The approach to the course includes the study of selected legislation, court cases, and research findings that assist in understanding formal constraints that affect the operation of the health system. 3 units.

HA 350. The Administrative Residency. The administrative residency is individually designed and provides a significant set of participatory experiences in various components of the health system. The two purposes of the residency are to broaden the student's knowledge of the actual operation of the system and to improve further the student's ability to utilize in real settings the skills developed during the academic phase of training. During the residency, the student is placed in three general areas: a broad systems exposure; an organization of secondary interest; and an organization of primary interest. The systems exposure includes a field experience with the Hospital Section of the Duke Endowment and other broadly oriented agencies in the health field. Examples of interest areas that may be selected include: general and special hospitals, nursing homes, clinics, health maintenance organizations, mental health organizations, health departments, prepayment plans, and planning agencies. During this period the student is provided with a stipend. Credit by arrangement.

HA 360. Seminar in Health Administration. A series of seminars held at the end of each quarter during the administrative residency. The seminars are designed to complement the experience obtained during the residency and to add depth to the material covered during the academic phase of the program. Credit by arrangement.

MS 300. Managerial Economics. Development of the fundamental theory of economic enterprise and use of that foundation in the analysis of economic operations. Theories of production, demand, and market behavior are developed to examine transformation and transaction operations of the firm. Emphasis is on optimum solutions to problems of internal efficiency and on the design of cooperative and competitive strategies for the economic enterprise. 4 units.

MS 302. Planning and Internal Organization. Short-run planning with emphasis on linear economic models and long-run planning with emphasis on capital budgeting models. Design of internal structure and management information systems for planning, implementation, and control. 4 units.

MS 310. Mathematics for Management. Mathematics for optimization with and without constraints in linear and nonlinear systems. Topics include partial derivatives, LaGrange multipliers, Kuhn-Tucker conditions, matrix algebra, and linear programming. 4 units.

MS 311. Probability and Statistics. Foundations of probability theory and statistical decision theory. Topics include: events, random variables, distributions, expectation, independence, functions of random variables, Central Limit Theorem, Bayes Law, elementary utility theory, sequential decision problems, use of experiments in decision problems, and an introduction to classical statistical inference. 4 units.

MS 312. Operations Research. The development of quantitative models for analysis of management decision problems. Topics include post-optimality analysis of linear programming, network analysis, game theory, dynamic optimi-

zation models, and queuing theory. Several of these techniques are applied to the analysis of inventory problems. 4 units.

MS 320. Organization Analysis and Operations Design. Analysis of organizations, emphasizing functional operations and design of the organization structure. Topics include determination of organization structure, the mechanisms of coordination, the requirements of information, the design and use of decision rules, the choice of a partitioning scheme for the organization, the mechanisms of control, and the interaction among them. 4 units.

MS 330. Accounting and Control Systems. Use of accounting data for planning, evaluating and controlling activities of the enterprise. Special consideration is devoted to the requirements for data in the models and methods useful in modern forecasting, planning, and control. 4 units.

Physical Therapy

ANA 300. Gross Anatomy. Gross anatomy for physical therapy students. Credit to be arranged; maximum—8 units. *Blake and Staff*

PHS 200. Physiology of Man. An introduction to the basic concepts of physiology with particular reference to man. Three lectures, one laboratory, and two conferences per week. 6 units. *Graduate Staff*

PT 217. Physical Therapy Dynamics I. Orientation to patient care; principles of biomechanics; developmental patterns of movement and posture; theory and practice of selected therapeutic methods. 3 to 4 units. *Branch, Mathews, Villanueva, and Staff*

PT 218. Physical Therapy Dynamics II. Regional approach to functional anatomy; principles and practice of physical therapy; biophysical and physiological considerations for utilization of selected therapeutic agents (mechanical, thermal, chemical, and electrical), with emphasis on methods of neuromuscular re-education. 5 units. *Villanueva and Staff*





PT 220. Physical Therapy Dynamics III. Principles and practice of physical therapy; principles of prevention of deformity and disability; methods of facilitation of functional capacity; use of orthotic and prosthetic devices; synthesis of theory and practice in planning effective treatment programs. 2 to 4 units. Villanueva and Staff

PT 230. Physical Evaluation and Instrumentation. Principles and techniques of objective assessment and analysis of functional status as performed by the physical therapist, including manual muscle tests, goniometry, electrical diagnostic testing, posture analysis, body measurements, evaluation of respiratory and sensory function, checkouts for prosthetic devices, disability evaluation, provocation testing, and orientation to electromyography and dynamometry. 3 units. Staff

PT 236. Medical Sciences. Lectures by clinicians with patient demonstrations and correlation of treatment methods; medical and surgical, neurological, orthopaedic, and emotional conditions affecting human dysfunction; emphasis on psychodynamic principles of patient-therapist relationships. 4 units. Staff and Special Lecturers

PT 238. Introduction to Health Service Systems. Political, economic, and sociocultural aspects of the organization of health care systems; structural components and interrelationships; criteria for assessing and analyzing health care systems. 2 to 3 units. Mathews

PT 242. Directed Clinical Experience in Physical Therapy I. Students are assigned to hospitals, rehabilitation centers, schools for crippled children, extended care facilities, and public health units for short-term supervised learning experiences. 1 to 2 units. *Staff*

PT 243. Directed Clinical Experience in Physical Therapy II. Students are assigned to full-time learning experiences under direction. 2 to 4 units. *Staff*

PT 301. Introduction to Scientific Inquiry. Theory and use of analytical methods of problem-solving; elements of scientific writing; preparation of a research protocol and a major paper. 3 units. *Mathews*

PT 332. Administration of Physical Therapy Services. Principles of administration, leadership styles, and management roles; concepts of systems theory and analysis; planning, organizing, delivering, and evaluating physical therapy systems and subsystems. 3 units. *Mathews*

Map of the Medical Center



1. Gerontology
2. M & No. 3
3. Clinical Research No. 1
4. Main Entrance Hospital
5. Clinical Research No. 2
6. Baker House
7. School of Medicine (Davison Building)
8. Duke Hospital
9. Bell Bldg.
10. Hanes Annex
11. Hanes House
12. Graduate Center
13. Medical Sciences Bldg. No. 1
14. Training Center Bldg. No. 1
15. Marshall Pickens Rehab. Ctr.
16. Training Center Bldg. No. 2
17. Research Park Bldg. No. 1
18. Research Park Bldg. No. 2
19. Research Park Bldg. No. 3
20. Research Park Bldg. No. 4
22. 220 Anderson St.
23. Child Guidance Clinic
24. Warfum
25. 2015 Ewin Road
26. 2013
27. Cuytan Bldg.
28. M. C. Personnel Bldg.
29. Volatile Storage
33. 2214 Ewin Road
34. 2212 Ewin Road
44. Maint. Wise. & Garage
48. Medical Research Laboratories (Old Laundry)



A stylized stained glass window illustration at the top of the page. It features three vertical panels. The left panel shows a building with a gabled roof and multiple windows. The middle panel contains a large cluster of white flowers. The right panel depicts a classical building with columns and a triangular pediment. The entire illustration is set against a dark blue background.

BULLETIN of Duke University

1974

1975



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Contents

University Administration	iv
School of Forestry Faculty and Staff	iv
Calendar of the School of Forestry	vi
1 General Information	1
Duke and the School of Forestry	1
2 Program Information	3
Related Fields	3
Master of Forestry Degree	4
Master of Science Degree	8
Master of Arts Degree	9
Doctor of Forestry Degree	9
Doctor of Philosophy Degree	9
General Requirements for the D.F. and Ph.D. Degree	10
3 Cooperative Plan of Study	15
Program with Selected Colleges and Universities	15
4 Admission	19
5 Registration and Regulations	23
Registration	23
Academic Regulations	25
6 Resources for Study	27
General and Research Facilities	27
7 Student Life at Duke	31
Living Accommodations	31
Services Available	33
8 Financial Information	37
Tuition and Fees	37
Living Accommodations	38
Motor Vehicles	38
Student Aid	39
Loans	40
9 Courses of Instruction	43
Appendix	53

University Administration

General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., President
John O. Blackburn, Ph.D., Chancellor
Frederic N. Cleaveland, Ph.D., Provost
Charles B. Huestis, Vice President for Business and Finance
William G. Anlyan, M.D., Vice President for Health Affairs
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J. Peyton Fuller, A.B., Controller
J. David Ross, J.D., Director of Development and Director of Campaign Planning
Harold W. Lewis, Ph.D., Vice Provost and Dean of Faculty
John C. McKinney, Ph.D., Vice Provost and Dean of the Graduate School
Anne Flowers, Ed.D., Acting Vice Provost and Acting Dean of Trinity College of Arts and Sciences
Frederick C. Joerg, M.B.A., Assistant Provost for Academic Administration
Joel L. Fleishman, LL.M., Vice Chancellor for Public Policy Education and Research; Director of Institute for Policy Sciences and Public Affairs
Benjamin Edward Powell, Ph.D., Librarian
William E. King, Ph.D., University Archivist
Clark R. Cahow, Ph.D., University Registrar
Victor A. Bubas, B.S., Assistant to the President
Rufus H. Powell, LL.B., Secretary of the University
A. Kenneth Pye, LL.M., University Counsel

School of Forestry Administration

Charles William Ralston, M.F., Ph.D., Dean of the School of Forestry
Fred Myerle White, M.F., Director of the Duke Forest and Assistant to the Dean
Leon Edward Chaiken, M.F., Director of Admissions
Roger Fabian Anderson, M.S., Ph.D., Director of Graduate Studies in the Department of Forestry of the Graduate School

School of Forestry Faculty and Staff

Roger Fabian Anderson (1951), M.S., Ph.D., Professor of Forest Entomology
Robert Lloyd Barnes (1965), M.F., Ph.D., Professor of Forest Biochemistry
Leon Edward Chaiken (1952), M.F., Professor of Forest Management
Frank J. Convery (1971), M.S., Ph.D., Assistant Professor of Natural Resource Economics
Henry Hellmers (1965), Ph.D., Professor of Botany
Frederick Charles Joerg (1947), M.B.A., Professor of Forest Management
Kenneth Richard Knoerr (1961), M.F., Ph.D., Professor of Forest Meteorology
Jane Philpott (1951), Ph.D., Professor of Botany and Professor of Wood Anatomy
Charles William Ralston (1954), M.F., Ph.D., Professor of Forest Soils
William James Stambaugh (1961), M.S., Ph.D., Professor of Forest Pathology
Fred Myerle White (1959), M.F., Assistant Professor of Silviculture
James Edward Wuenscher (1970), M.S., Ph.D., Assistant Professor of Forest Ecology
David Owen Yandle (1967), M.S., Ph.D., Associate Professor of Forest Mathematics

Associate Faculty

Donald J. Fluke, Ph.D., Professor of Zoology
Aubrey W. Naylor, Ph.D., Professor of Botany

Adjunct Faculty

Edgar W. Clark, Ph.D., Adjunct Associate Professor of Forest Entomology
Milton S. Heath, Jr., LL.B., Adjunct Professor of Environmental Law
Charles S. Hodges, Jr., M.F., Ph.D., Adjunct Associate Professor of Forest Pathology
Louis J. Metz, M.F., Ph.D., Adjunct Associate Professor of Forest Soils
Fred M. Vukovich, Ph.D., Adjunct Associate Professor of Forest Meteorology

Staff

Patricia S. Rarie, Recorder and Secretory to the Dean
E. Otto Griffin, Jr., Superintendent, Duke Forest
Edwina Johnson, B.S. in L.S., Librarian, Forestry-Biology Library
Sue P. Hicks, Secretary, Duke Forest
Nancy A. McMannen, Secretary
Ja W. Russell, Secretary

Faculty Emeriti

*Ellwood Scott Harrar, Ph.D., James B. Duke Professor Emeritus of Wood Science
Paul Jackson Kramer, Ph.D., James B. Duke Professor Emeritus of Botany
James Granville Osborne, B.S., Professor Emeritus of Forest Biometry
Albert Edward Wackerman, M.F., Professor Emeritus of Forest Utilization
Frederick Adolphus Wolf, Ph.D., James B. Duke Professor Emeritus of Botany*



School of Forestry Calendar 1974-1975

1974

August		
	29-30	Wednesday-Friday—Consultation with advisers for new students
	31	Saturday—Registration and matriculation for all students who have not preregistered in the School of Forestry
September	3	Tuesday—Fall semester classes begin
November	27-29	Wednesday-Friday—Thanksgiving Break
December	2	Monday—Classes resume
	10	Tuesday—Fall semester classes end
	13	Friday—Final examinations begin
	20	Friday—Final examinations end

1975

January		
	9-10	Consultation with advisers for new students
	11	Saturday—Registration and matriculation for all students who have not preregistered in the School of Forestry
	13	Monday—Spring semester classes begin
March	17-21	Spring Break—Spring Field Trips
April	25	Friday—Spring semester classes end
	29	Tuesday—Final examinations begin
May	6	Tuesday—Final examinations end
	11	Sunday—Baccalaureate and Commencement





1

General Information

Duke and the School of Forestry

Duke University, located at Durham, North Carolina, comprises Trinity College of Arts and Sciences, the School of Engineering, the Graduate School, and the professional schools of Forestry, Divinity, Law, Medicine, Business Administration, and Nursing. The University dates from 1838, when Union Institute was founded in Randolph County by the Methodists and Friends. In 1851 the institution became Normal College, one of the first schools in America for the training of teachers. In 1859 the name was changed to Trinity College and so continued until 1924, when the College became a part of Duke University.

By virtue of an indenture of trust, executed December 11, 1924, by James Buchanan Duke, there was a great benefaction, providing for hospitalization, church work in rural communities, and education. The principal feature of the educational provision was the creation of Duke University.

The University, with a student body totaling 8,000, occupies two campuses. The East Campus of 108 acres was formerly the campus of Trinity College. About a mile west are the newer units of the University, known as the West Campus, totaling 467 acres. It was first occupied in September, 1930.

Forestry at Duke University began early in 1931 when the Duke Forest was placed under intensive forest management and forestry research was initiated. An academic-forestry curriculum, designed for men and women intent upon pursuing the study of forestry as a profession, was organized in Trinity College of Duke University in 1932. This program was enlarged in 1952 and now includes more than sixty cooperating colleges and universities. (See pages 16-17.)

In 1938 the School of Forestry was organized at the graduate level and a curriculum was offered leading to the degree of Master of Forestry. Work leading to the degree of Doctor of Forestry has been offered since 1940. The School has been fully accredited since its origin. A degree in forestry at the undergraduate level is not offered at Duke University.

Graduates of recognized colleges and universities, professional schools of forestry, and other students who meet the entrance requirements of the School (see page 19), may enroll in forestry programs leading to the professional degrees—Master of Forestry and Doctor of Forestry. The Department of Forestry in the Graduate School also offers graduate work in certain aspects of forestry leading to the degrees of Master of Science and Doctor of Philosophy. This work is available to graduates of schools of forestry of recognized standing, and to college or university graduates holding a bachelor's degree. All applicants will be considered without regard to race, color, religion, sex, or national origin.



2

Program Information

Related Fields

Basic scientific or professional programs of study are available in the following fields of forestry and related natural resources. Interdisciplinary programs between fields within the School of Forestry and those in other departments of the University also are possible and strongly encouraged.

Biological Science

Forest Ecology
Tree Physiology and Biochemistry
Forest Pathology
Forest Entomology
Dendrology and Wood Anatomy

Environmental Science

Forest Soils
Forest Meteorology and
Biometeorology
Wildland Hydrology

Statistics and Operations Research

Biometry and Statistics
Mensuration
Operations Research

Economics and Management

Natural Resources Economics and
Policy
Forest Management

With exception of forest management, study in all of the above fields can be pursued in programs for a M.S., A.M., or Ph.D. degree in the Department of Forestry of the Graduate School, or in a professional program for a M.F. or D.F. degree from the School of Forestry. Work in forest management is in professional M.F. and D.F. degree programs of the School of Forestry. Students contemplating careers in teaching and research are strongly urged to follow courses of study in the Department of Forestry in the Graduate School.

In addition, the following special management or business-oriented programs of study leading to the M.F. degree are available in the School of For-

stry: Post Liberal Arts and Science Program, Business Management Program, Forest Protection Program, Cooperative Forestry Program, and Natural Resource Ecology and Environmental Management Program.

Detailed information on these special programs is given under the Master of Forestry Degree and the Cooperative Plan of Study sections in this Bulletin.

Courses available in the various fields of forestry and related natural resources are indicated in a later section of this Bulletin.

Master of Forestry Degree

The requirements for the degree Master of Forestry (M.F.) are governed by the extent of the student's previous undergraduate education, both in professional and related subjects, and by his specific career objectives. Normally, students who have earned the degree of Bachelor of Science in Forestry, or the equivalent, from an accredited school of forestry, may complete the requirements for the M.F. degree in one academic year. Depending on prior preparation and the field in which he desires to concentrate, a student without previous education in forestry will be required to complete the equivalent of either four or five semesters of resident study. Graduate work of equivalent grade done in residence at other institutions may, with the approval of the faculty, be accepted as credit toward the degree, but a minimum of one year of residence at Duke University is required.

The submission of a thesis for the M.F. degree may be required. With the approval of the faculty, an acceptable report on a special study may be submitted in lieu of a thesis, credit for which will not exceed three units. Four copies of the thesis, typewritten and bound in accordance with regulations set forth by the faculty, must be deposited with the dean of the School of Forestry on or before April 15 of the academic year in which the student expects to obtain the M.F. degree.

A student who has not completed his thesis while in residence must submit an acceptable manuscript to the faculty within a period of two years following the termination of his residence.

No student may take less than 14 nor more than 18 units of credit per semester without special permission of the faculty (see pages 23-24).



Post-Liberal Arts and Science Program. Men and women who are college graduates but have had no prior professional forestry training may be admitted to programs to study leading to the degree of Master of Forestry. Depending on the program of study, 60 to 70 units of credit in residence are minimal requirements, including the core courses listed below. In the case of students with advanced preparation relevant to these specific educational objectives, total unit credit requirements may be reduced. Any such reductions will be approved on individual bases and only with specific recommendation of the student's major program adviser and approval by the faculty.

Core courses normally are completed during the first year of residence. However, students lacking prerequisites for specific courses may postpone such courses until the prerequisites have been completed.

Core Courses

	Units
Tree Growth and Development (For. 205)	3
Soils and Forest Resources (For. 261)	3
Resource Economics and Policy (For. 269)	3
Forest Ecology (For. 243)	3
Dendrology (For. 241)	3
Careers in Natural Resources (For. 200)	0

During the latter part of the first year, each student will be requested to designate the field (or fields) he wishes to pursue for a major. After the student has designated his field of interest, he will be assigned a faculty adviser who, in consultation with the student, will develop a program of study in a manner similar to that described under the Post-Professional Program (see below).

Any student who does not earn a grade of E or G in at least six units of work in the first academic year will not be permitted to enter into the work of the second year.

Post-Professional Program. Students with satisfactory undergraduate professional training qualify for advanced study and research in the various disciplines of forestry under this program. A specific study plan is developed for each student through consultation with a faculty advisory committee. For the student planning a managerial career in the general area of forest production (and where the Master of Forestry is planned as a terminal degree), his program of study usually consists of courses and seminars, with a major portion of the work concentrated in the area of the student's interests. For the student with research interest, the study plan is oriented within the subject matter field of interest toward the furtherance of a research career, or toward preparing him for academic training beyond the master's level.

A number of courses offered in other departments of the University are open to qualified students in the School of Forestry. One or more of these may be included in a student's study plan when considered advisable by his advisory committee.

A minimum of 30 units, in which the student must earn a grade of E or G in at least 6 units, are required for the degree of Master of Forestry, under this program. Normally, 15 units of credit (including the thesis) must be earned in the School of Forestry.

Business Management Program. A specialized program is offered in the School of Forestry in cooperation with the Department of Economics to prepare



forestry graduates for managerial careers in the business aspects of industrial forest land management or forest products. The program requires two years of study and training leading to the degree of Master of Forestry. It is open to selected students who have earned a bachelor's degree (or the equivalent) in general forestry, forest management, forest utilization, or wood science and technology, with the proper prerequisites, and who also have potential leadership qualities indicative of administrative and executive capacity.

The general requirements of the program are as follows:

1. At least 10 courses (30 units) in economics and business administration or in closely allied fields.
2. Approximately 5 courses (15 units) in forestry which deal with principles of administration and decision-making.
3. Experience as a paid managerial trainee with a cooperating firm for a period including the fall semester of the second year and the preceding summer.
4. A written analysis of some phase of the managerial operation of the organization with which the training period is spent.

A specific program of study, commensurate with each student's academic background and future goals, will be developed by the program advisory committee in consultation with the student. A sample list of suggested courses included in such a program of study is available upon request.

Students entering the program must meet the admission requirements of the School of Forestry and be approved by a committee representing the faculties of Economics and Forestry. The financial award benefits of the School of Forestry are available to applicants for this program (see pages 39-41). Application forms for admission and financial aid may be obtained from the director of admissions of the School of Forestry upon request.

Forest Protection Program. A combined program of specialization in entomology-pathology is available for students desiring career preparation in the applied aspects of forest insect and disease control. This program of study leads to the Master of Forestry degree. Students electing the program must hold either a bachelor's degree in general forestry or have equivalent preparation in the biological sciences.

The general requirements of the program are as follows:

1. A minimum of 28 units in forest entomology and forest pathology. With approval, credits in closely related disciplines may be substituted.
2. At least 12 units of courses and seminars dealing with managerial and statistical aspects of forest protection.
3. One summer of employment experience with a forest protection agency.
4. Organization, conduct, and report of applied research on a forest insect and/or disease problems (4 units).

Reasonable latitude will be permitted in selecting courses to accommodate specific needs and interests. Each program of study will be developed in consultation with the program directors. A list of recommended courses is available upon request.

Applicants for this program must meet the requirements of the School of Forestry and the approval of the program advisory committee. Application forms for admission and financial aid may be obtained from the director of admissions of the School of Forestry.

Natural Resource Ecology and Environmental Management Program. A professional program is offered to students with career interests in the expanding fields of environmental management and protection. The basic objective of this program is to develop expertise in planning and administering the management of natural resources and the non-urban environment for maximum human benefits with minimum deterioration of ecosystem stability. Emphasis is placed on the ecosystem as the basic unit of natural resource management.

This program of study leads to the Master of Forestry degree and is open to students with a bachelor's degree in biological or environmental science or with training in other fields but strong motivation toward an ecological approach to natural resource problems.

General requirements of the program are:

1. A minimum of 24 units in resource ecology and environmental science.
2. At least 9 units of courses dealing with statistical or mathematical analysis of natural resource problems.

3. A minimum of 15 units of courses in resource use planning, business, and public administration.

4. Formulation, analysis, and report of research on an applied problem related to ecological or environmental aspects of natural resource management.

Although all students are expected to have substantive knowledge of principles of resource ecology, environmental science, and quantitative analysis, reasonable latitude is permitted in electing courses to meet the interests and capabilities of individual students. Each program of study will be developed in consultation with the program directors.

Application forms for admission and financial aid may be obtained from the director of admissions of the School of Forestry.

Program in Tropical Forestry. Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section Organization for Tropical Studies in the *Graduate School Bulletin* in the chapter Special and Cooperative Programs.

Master of Science Degree

Prerequisites. The degree of Master of Science (M.S.) is offered through the Department of Forestry in the Graduate School. As a prerequisite to this degree a student must have earned a baccalaureate degree from an accredited college or university. There is no foreign language requirement for this degree.

Major and Minor Subjects. The work for the Master of Science degree is designed to provide a basic foundation in a fundamental area of forestry or in a field closely allied with forestry. A minimum of 30 units of credit is required for the degree; 24 units must be in formal courses although not more than 6 units can be earned for the thesis. Specific course requirements call for a minimum of 12 units in a major field of specialization and 6 units in a minor area of concentration. The major and minor fields are determined without regard to departmental divisions of the University if the interdisciplinary nature of the area of specialization makes such a program of study advisable. The specific program of study is developed by the major professor (thesis supervisor), subject to the approval of the director of graduate studies in forestry and the dean of the Graduate School.

The Thesis. At least one month before presenting the thesis, that is on or before February 1 for a May degree or on or before August 1 for a September degree, the student must file with the dean of the Graduate School, on the official form, the title of the thesis and the declaration of intention to graduate. The title must have the approval of the thesis supervisor and the director of graduate studies in the major department. If the student has met the degree requirements before the above deadlines, he must file his intention to graduate one month before the thesis is presented.

All basic requirements for preparing the thesis are described in the *Manual of Style for Theses and Dissertations*, revised 1961, obtainable at the Duke University Book Store, West Campus. The quality of paper, form, and binding are prescribed in the *Manual*.

Four typewritten copies of the thesis, bound in snap binders supplied by the Library, must be submitted through the Graduate School Office to the dean of the Graduate School on or before April 15 for a May degree or on or

before August 15 for a September degree, and at least one week before the scheduled date of the student's examination. The copies will then be distributed by the student to the several members of the examining committee. Three copies for the Library will be bound by the Ruzicka Bindery for a fee of \$5.00 a volume. The student may request that an additional number of copies be so bound.

The Examining Committee and the Examination. The instructor who directs the student's program appoints an examining committee composed of himself and two other members of the graduate faculty, one of whom must be from a department other than that of the major. If the student has been permitted to take related work within the major department, the third member may represent the minor field within the department. This committee is submitted for approval to the dean of the Graduate School at least one week preceding the final examination.

The student's committee administers the examination and certifies whether the student has passed or failed by signing the card provided for this purpose by the Graduate School Office. This card is used to indicate completion of all requirements for the degree. After a thesis is approved the committee also signs all copies of the thesis, and the candidate then returns the original, the first two carbon copies, and any other copies he wishes bound by Ruzicka to the dean of the Graduate School who deposits them in the University Library.

Master of Arts Degree

The degree of Master of Arts (A.M.) is offered through the Department of Forestry in the Graduate School. As a prerequisite to admission for this program, a student must have earned a baccalaureate degree from an accredited college or university. Students interested in working toward this degree should refer to the Bulletin of the Graduate School for specific requirements.

Doctor of Forestry Degree

The degree of Doctor of Forestry (D.F.) is a professional and research degree conferred upon those students who have satisfactorily completed specified requirements of advanced study and research.

Work toward the D.F. degree, consisting of advanced studies in a major and a minor field, is offered with majors in the several branches of forestry. A minor may be elected in forestry or in other areas of specialized study in the University approved by the faculty of the School of Forestry. Prospective students should correspond with the director of admissions of the School of Forestry on all matters pertaining to admission to the School.

Doctor of Philosophy Degree

The Doctor of Philosophy degree (Ph.D.) is conferred through the Graduate School of Duke University. Programs of study and research for men and women working for this degree are directed by faculty members of the School of Forestry who also comprise the graduate faculty of the Department of Forestry in the Graduate School. Both major and minor programs of study are available in the following branches of forestry: forest biochemistry, forest biometry, forest meteorology, forest ecology, forest economics, forest entomology,

forest hydrology, forest pathology, forest soils, forest-tree physiology, and wood science including wood anatomy, and wood chemistry.

The Ph.D. degree is essentially a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not be sufficient for attaining this degree. The granting of the Ph.D. is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

General Requirements for the D.F. and Ph.D. Degrees

The formal requirements, discussed in detail below, for the doctoral degrees are as follows: (1) foreign language; (2) major and related courses; (3) supervisory committee for program of study; (4) residence; (5) preliminary examination; (6) dissertation; and (7) final examination. In order to be considered for candidacy for a doctoral degree, the student must have passed all of his course work in the first year of graduate study; on at least 9 units of course work in the first year, he must have made a grade of G or better.

Foreign Language Requirements. A reading knowledge of at least one foreign language is required for the D.F. and Ph.D. degrees. Languages normally taken are French, German, and Russian. Another language which has a definite relation to the degree program and for which an examination can be provided may be substituted for any of these with the approval of the supervisory committee.

A foreign student whose native language is not English may request that the director of graduate studies ask permission of the dean of the Graduate School to offer English as the foreign language required in his program.

With the special approval of the dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. may be waived in individual cases provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the student concerned.

The foreign language requirement(s) may be satisfied in the following ways:

1. The student may take the Educational Testing Service examinations at many national centers (including the Duke University Counseling Center). To avoid delays, prospective students are urged to take appropriate ETS Graduate School Foreign Language tests prior to registration. However, it should be noted that at the time of the final examination in a master's program or of the preliminary examination in a doctoral program, language certificates more than six calendar years old will not be accepted toward fulfilling the language requirement.
2. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School Office and administered by a qualified examiner.

Special Reading Courses. Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week. French is offered during the fall semester and occasionally also in the spring and German during the spring semester and the summer session. A student who registers for either course must reduce his normal load

of graduate courses by 3 units, with no reduction in fees. No auditors are permitted in these courses at any time. Undergraduates may not enroll during the academic year but may register, with permission of the dean of the Graduate School, in the summer session if total registration permits.

Major and Related Work. The student's program of study necessarily demands substantial concentration on courses in his major department. It must, however, include a minimum of 6 units in related fields approved by his major department. Use of related fields within the major department requires the approval of the dean.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable and not later than two months before the preliminary examination, the director of graduate studies in the major department will nominate for the approval of the dean a supervising committee of five, with one member designated as chairman. This committee will include at least three members of the major department and one from the minor department, if a minor is involved. This committee will approve the program of study, as well as administer the preliminary examination and the final doctoral examination. Should all members of the committee be from the major department, at least one member of another department will be added or substituted for the final doctoral examination. The final examination may be administered with a minimum of four members.

When the preliminary examination is arranged, the committee and the director will submit to the dean the student's program of study bearing a statement that the department's course and language requirements have been, or are being, completed.

Residence. The minimum registration requirement is 60 units of graduate credit, not more than 30 units of which may be accepted by transfer. Since a full program is 30 units per academic year, the prospective doctoral candidate who enters with an A.B. or B.S. degree must plan to spend in residence a minimum of two academic years; if he enters with an A.M., M.S., or M.F. degree, his minimum residence is one academic year. If there are undergraduate deficiencies in his program, he may, in addition to the minimum requirements, be required to take preliminary undergraduate courses for which he will not receive graduate credit. Even if there are no such undergraduate deficiencies, the student's supervisory committee will determine what requirements, if any, above the minimum the student must meet. See pages 24-25 for further information on registration in residence and in absentia.

When the preliminary examination is passed, any courses, language certifications, or other credits for advanced standing which are more than six calendar years old will not be accepted toward fulfilling the minimum requirements of the doctoral degree.

The student should normally pass the preliminary examination by the end of his second year of graduate study. If he has not passed it by the middle of the third year, he must file with the dean a statement explaining the delay and setting a date for the examination. Except under unusual circumstances, extension will not be granted beyond the end of the third year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate, with the approval of his committee, may petition the dean for an extension of one year. Should this extension be granted and the dis-

sertation not be submitted and accepted within the year, the student must pass a second preliminary examination to remain a doctoral degree candidate. In such a case, the time limit for submitting the dissertation will be determined by the dean and the candidate's committee.

Preliminary Examination. A student is not accepted as a candidate for the doctoral degree until he has passed the preliminary examination. A transfer student who may have passed a preliminary examination elsewhere must, nevertheless, take the examination at Duke. The examination ordinarily covers both the major and minor fields.



In the summer, a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and the dean, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Failure on the second examination will render the student ineligible to continue his program for the doctoral degree at Duke University.

The Dissertation. The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

Not later than February 1 (February 2, if February 1 falls on Sunday) preceding the May commencement at which the degree is expected to be conferred, the student must file with the dean of the appropriate school, on the official form to be obtained from the Graduate School Office, the title of the dissertation. This title must receive the written approval of both the director of graduate studies of the student's major department and the professor who directs the dissertation.

The basic requirements for preparing the dissertation such as quality of paper, form, and binding are prescribed in the instructions for microfilming (see below) and in the *Manual of Style for These and Dissertations*, revised 1961, which may be obtained from the Duke University Book Store, West Campus.

The dissertation must be completed to the satisfaction of the instructor who directs it. Four typewritten copies bound in snap binders secured through the Graduate School Office must be deposited with the dean of the appropriate school on or before April 1 preceding the May commencement when the degree is to be conferred. The dissertation must be submitted at least seven days before the scheduled date of the student's examination.

All doctoral dissertations will normally be published on microfilm through University Microfilms, Ann Arbor, Michigan. Authors may, if they wish, also copyright them. An abstract will be published in *Dissertation Abstracts*. Before final typing is completed, the candidate should obtain, in the Graduate School Office, detailed instructions on the procedure, together with a microfilming agreement which is signed and returned when the dissertation is finally deposited in the Graduate School Office.

In brief, all copies of the dissertation, the original in clean type, will remain unbound except for spring binders. Ten copies of an abstract, carefully written and not more than 600 words long, are submitted when the dissertation is first presented. A non-returnable dissertation fee of \$25 is charged for handling and microfilming. If copyright is desired, an additional fee of \$7 plus 2½ cents per page is charged. The original and two carbon copies will be bound by the Ruzicka Bindery for a fee of \$5.00 a volume. The student may request that more than the three copies be so bound.

Final Examination. The final oral examination shall be based primarily upon the dissertation. Questions may, however, be asked in the candidate's major field. Except in unusual circumstances, approved by the dean, a final examination will only be scheduled when school is in session.

If a student fails his final examination, he may be allowed to take it for a second time, but not sooner than six months from the date of his first. Permission to take the second examination must be obtained from the instructor who directed the dissertation and from the dean. Failure to pass the second examination renders the student ineligible to continue work for the doctoral degree at Duke University.



3

Cooperative Plan of Study

Program with Selected Colleges and Universities

Since its inception the Duke School of Forestry has had the cooperation of Trinity College (the undergraduate college of arts and sciences of Duke University) in preparing students for professional careers in forestry. Under the plan, a student devotes his first three years to a coordinated and carefully integrated program of study in the basic arts and sciences in Trinity College. The following five semesters are spent in the School of Forestry, and normally upon successful completion of 70 units of credit in a professional program of study, a student will have earned the Bachelor of Science degree from Trinity College and the professional Master of Forestry degree from the Duke School of Forestry. In the case of students with advanced preparation relevant to their specific educational objectives, total unit credit requirements may be reduced. Any such reductions will be approved on individual bases and only with specific recommendation of the student's major program adviser and approval by the faculty.

Based upon the experience and success of this cooperative program with Trinity College, the School of Forestry in 1952 initiated similar programs of collaboration with a selected group of colleges and universities located throughout the United States. These programs offer students the numerous advantages of a broad background in liberal arts and sciences as preparation for later professional training. A student intent upon following such a course of study should make application to one of the colleges listed on pages 16-17. Admission requirements and other information pertinent to matriculation may be obtained from each of these institutions. Not later than the end of the first semester of the third year in the college or university of his choice, the student may take formal application for admission to the Duke University School of

Forestry. To qualify for admission under these programs, a student must have followed a course of study arranged in consultation with his adviser, must have the official recommendation of his college, and must meet the minimum requirements for admission to the Duke School of Forestry.

Institutions in the Academic-Forestry Program

Alobomo		
	Samford University	Birmingham 35209
Arkonsos		
	Little Rock University	Little Rock 72204
Colorodo		
	Colorado College	Colorado Springs 80903
Florida		
	Florida Southern College	Lakeland 33802
	Rollins College	Winter Park 32791
	Stetson University, College of Liberal Arts	DeLand 32720
Georgio		
	Mercer University	Macon 31207
Illinois		
	Illinois Wesleyan University, College of Liberal Arts	Bloomington 61710
Indiono		
	Butler University College of Liberal Arts and Sciences	Indianapolis 46208
	Franklin College	Franklin 46131
	Indiana Central College	Indianapolis 46227
Iowa		
	Iowa Wesleyan College	Mount Pleasant 52641
Konsos		
	Baker University	Baldwin 66006
Louisiono		
	Centenary College of Louisiana	Shreveport 71104
Moryland		
	Western Maryland College	Westminster 21158
Michigan		
	Albion College	Albion 49224
Mississippi		
	Millsaps College	Jackson 39210
Missouri		
	William Jewell College	Liberty 64068
Nebrosko		
	Doane College	Crete 68333
New Jersey		
	Drew University, College of Liberal Arts	Madison 07940
New York		
	Hofstra University	Hempstead, Long Island 11550
North Corolino		
	Catawba College	Salisbury 28114
	Duke University, Trinity College	Durham 27706
	Guilford College	Guilford College 27410
	High Point College	High Point 27262
	Wake Forest University	Winston-Salem 27106
Ohio		
	Baldwin-Wallace College	Berea 44017
	Denison University	Granville 43023
	Heidelberg College	Tiffin 44883
	Kent State University, College of Liberal Arts	Kent 44240
	Marietta College	Marietta 45750
	Miami University, College of Arts and Sciences	Oxford 45056
	Ohio University	Athens 45701
	Otterbein College	Westerville 43081
	Wittenberg University	Springfield 45501
	Youngstown State University	Youngstown 44503
Oregon		
	Reed College	Portland 97202
	Willamette University, College of Liberal Arts	Salem 97301

Pennsylvania

Albright College Reading 19604
Elizabethtown College Elizabethtown 17022
Franklin and Marshall College Lancaster 17603
Gettysburg College Gettysburg 17325
Juniata College Huntington 16653
Lebanon Valley College Annville 17003
Lycoming College Williamsport 17704
Moravian College Bethlehem 18018
Muhlenberg College Allentown 18104
Thiel College Greenville 16125

South Carolina

Furman University Greenville 29613
Newberry College Newberry 29108

Tennessee

Carson-Newman College Jefferson City 37760
Chattanooga, University of, College of Liberal Arts Chattanooga 37403
East Tennessee State University Johnson City 37602
Lincoln Memorial University Harrogate 37752
Tennessee Wesleyan College Athens 37303
Tusculum College Greeneville 37743

Texas

Baylor University, College of Arts and Sciences Waco 76706

Virginia

Bridgewater College Bridgewater 22812
Randolph-Macon College Ashland 23005
Richmond, University of, Richmond College Richmond 23173
William and Mary, College of Williamsburg 23185

West Virginia

Davis and Elkins College Elkins 26241
Marshall University Huntington 25701
West Virginia Wesleyan College Buckhannon 26201

Wisconsin

Beloit College Beloit 53512





4

Admission

Master of Forestry Degree

The admission requirements of the School of Forestry for work toward the Master of Forestry degree presuppose that an applicant is either:

1. a graduate of a professional school of forestry, or
2. a graduate of a college or university of high standing, but without prior professional training in forestry, or
3. a student who has successfully completed three years of approved study at one of the colleges (listed on pages 16-17) cooperating with the School in the academic-forestry program.

Each applicant must present a certified transcript of his academic record showing the courses he has taken, the number of credit hours earned, and the grades received. Although specific courses are not required for admission, applicants must be aware that many fields within forestry require academic preparation of a specialized nature. Deficiencies, if any, may be satisfied in residence, possibly prolonging the time necessary to complete degree requirements. Students interested in specialized areas of forestry should write the dean for advice as to specific preparatory courses.

An applicant who is a graduate of a professional school of forestry will present a certified transcript of his scholastic record. Before registering for the first semester of residence, students will be required to select the branch or branches of forestry in which they wish to concentrate the major part of their work and to prepare their proposed programs in conference with an appropriate faculty advisory committee. Ordinarily, graduates of a fully accredited school of forestry should be able to meet all requirements for the Master of Forestry degree in one full school year of resident study; others may require a longer period of residence.



Doctor of Forestry Degreee

Admission to the School of Forestry for a program of study and research leading to the Doctor of Forestry degree is granted to a student who has received the Master of Forestry degree, or its equivalent.

An applicant must file a formal application for admission together with transcripts of his undergraduate and graduate academic records. In his application he should clearly state the branch of forestry in which he desires to concentrate, and, if possible, his specific research interests.

The director of admissions of the School of Forestry, together with the prospective student's major adviser, will determine if the qualifications of the applicant meet entrance requirements.

Master of Science and Doctor of Philosophy Degrees

Applications for admission into M.S. and Ph.D. programs in Forestry should be submitted to the director of admissions, Duke School of Forestry, for transmittal to the Office of the Dean of the Graduate School.

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. His undergraduate program should be well rounded and of such quality as to give positive evidence of the capacity for graduate study.

Applicants for all degree programs of the School of Forestry will be considered for admission without regard to race, color, religion, sex, or national origin.



5

Registration and Regulations

Registration

All students who enter course work or residence for credit; all students who have completed minimum requirements for an advanced degree, but continue to use the facilities of the University in their research; all students in *absentia* status; and all students who wish merely to audit a course or courses must register.

After the applicant has received notification of his admission to the School of Forestry and has returned his statement of acceptance of admission, he may present himself for registration. During the registration periods, announced in this Bulletin, he first confers with an assigned faculty adviser who prepares and signs a course card, listing the course work to be taken during the semester. The student then presents this course card to registration officials, who enroll him officially in his courses. After his first registration period as a current student he will preregister at the stated times for preregistration. Failure to preregister incurs the penalty for late registration. Former students who intend to register to resume a degree program must give the director of admissions notice of this intention two months before registration. A period of five weeks from the date of registration is provided for changes resulting from passing a preliminary examination.

Late Registration. All students are expected to register or preregister at the times stated in this Bulletin. Those registering late, including those who are obliged to register in *absentia*, are subject to a late registration fee of \$10.00.

Change of Registration. During the academic year within a period of fourteen days from the registration date, a student may change registration with the approval of his adviser, if no reduction of fee is involved, and with the approval of the dean if a reduction of fee is involved. During the first thirty days

from the registration date the only permissible change is dropping course-seminar registration and adding equivalent units of research, with the approval of his adviser, the instructor of the course, and the dean.

Normal Registration. A graduate student is designated as fully registered when he registers for the maximum credit his program requires. Required registration is set in consideration of the student's obligation to teach or assist and the stage he has reached in completion of degree requirements. In the academic year normal registration for the resident student who does not hold an appointment as part-time instructor or assistant, or does not engage in part-time work, is 15 units a semester or 30 units an academic year. The normal registration for the student who holds such an appointment or undertakes such work is either 12 units or a minimum of 9 units, depending upon the number of hours a week he is required to devote to such duties.

The resident student in a terminal master's program which requires no thesis carries normal registration until he has met all degree requirements. If a thesis is required and the student has met all requirements except for submitting his thesis, he registers for 3 units a semester while in residence or, if he elects to go out of residence, for 1 unit in *absentia* each semester until the thesis is accepted.

The resident student engaged in a master's program which is not terminal



but preparatory to a doctoral program registers as though he were a doctoral student.

The resident student in a doctoral program carries normal registration through the semester in which he passes the preliminary examination. If he remains in residence, he continues to register for a minimum of 3 units a semester until the dissertation is accepted. If, before or after passing the preliminary examination, he elects to go out of residence, he registers for 1 unit a semester in *absentia* in order to keep his program active.

It is necessary to be a fully registered student according to the regulations listed above (except when registered in *absentia*) in order to establish eligibility for library carrel and laboratory space, for student housing, for University and some outside loans, for the Student Health service including voluntary insurance coverage, and for reporting status for military duty.

The registration of 1 unit a semester in *absentia* provides occasional consultation with the thesis or dissertation supervisor. It may be waived for military duty or serious problems of health.

In the summer session 6 units a term is maximum registration. Students who are residents in the academic year and wish to continue study and the use of University facilities including Summer Session Student Health during the summer must register for 1 unit in the first summer session term. This registration provides use of these facilities for all terms.

Academic Regulations.

Transfer of Graduate Credits. Credit for graduate course work earned at another institution will be determined only after a student has spent one semester at Duke University. After completing his first semester, the student, through his director of graduate studies, should file a request that his credits be reviewed and a decision be made.

Grades. Grades in the School of Forestry are as follows: E (exceptional); G (good); S (satisfactory); F (failing); and I (incomplete).

An I (incomplete) indicates that some portion of the student's work is lacking, for an acceptable reason, at the time grades are reported. The instructor who gives an I for a course specifies the date at which the student must make up the deficiency, in no case more than one calendar year from the date the course ended. If the course is not completed, the grade of F is entered upon the student's record unless his appeal to the dean for the grade No Credit is approved.

A grade of F in any course normally occasions withdrawal from a degree program.

Reciprocal Agreements with the University of North Carolina and North Carolina Central University. Under a plan of cooperation between the University of North Carolina and Duke University, students regularly enrolled in the Graduate Schools of the University of North Carolina during the regular academic year, and paying full fees to that institution, may be admitted to a maximum of two courses per semester in the Graduate School of Duke University upon payment of a nominal registration fee of two dollars and of any other special fees regularly required of all students. Under the same arrangements, students in Forestry and the Graduate Schools of Duke University may be admitted to course work at the University of North Carolina and North Carolina State University. A similar arrangement exists with North Carolina Central University at Durham.



6

Resources for Study

General and Research Facilities

The School of Forestry is housed in the south wing of the Biological Sciences Building on the West Campus. General and research laboratories are provided for routine and original studies in all of the subject matter fields. These laboratories are equipped with instruments and facilities for quantitative evaluation of biological materials and processes. Greenhouses and the phytotron immediately adjacent to the Biological Sciences Building and the nearby Duke Forest offer excellent facilities for biological investigations in controlled and natural environments. An IBM system 370 Model 165 Digital Computer is available for processing research data via a teletype terminal at the School.

Facilities of allied departments of the University are also available for advanced work in chemistry, economics, genetics, mathematics, plant anatomy, plant ecology, plant pathology, and plant physiology.

West Virginia Pulp and Paper Company has made available to Duke University a field headquarters for work in the forests of the South Atlantic Coastal Plain. This camp, located eighteen miles northwest of Summerville, South Carolina, is used as a base for field instruction in timber harvesting, wood utilization, soils, silviculture, and forest management.

The School periodically sponsors conferences and symposia on industrial forest management and other technical and scientific subjects. These offer the current viewpoints of many outstanding individuals in both forestry and in allied fields.

The University library, with 2,000,000 volumes and 4,000,000 manuscripts, provides exceptional resources and facilities for study and research by undergraduate and graduate students, and by visiting scholars. About 80,000 volumes are added annually, and 164 foreign and domestic newspapers and

9,800 periodicals are received currently. Large collections of microfilms of rare books, newspapers, and periodicals are also available.

The Biology-Forestry library, Chemistry library, and Physics-Mathematics library are housed for convenience in the buildings of these departments. The libraries of the Schools of Divinity, Law, Medicine, and Engineering are also housed in the buildings of these schools, all on the West Campus. The library on East Campus includes another 171,000 volumes.

The Duke Forest. The Duke Forest, of approximately 8,000 acres, is particularly well situated for field work. A five-minute walk from the campus will take one well into many parts of the area, and even the most distant portions can be reached by automobile in about twenty minutes.

At few others places in America are there provisions for extensive field study and research in forestry literally at the door of a large university. This natural outdoor laboratory, so conveniently located and representative of the region, is a most valuable supplement to the instructional, laboratory, and library facilities of Duke University.

The forest lies mainly in Durham and Orange Counties near the eastern edge of the Piedmont Plateau. A cross section of much of the woodlands in the upper Coastal Plain and lower Piedmont of the Southeast is represented in the forest with its variety of topography, soil, forest conditions, and patterns of past land use. Elevations range from 280 to 760 feet. The soils are derived from such diverse parent material as metamorphic rock of the Carolina slate formation, granite, Triassic sedimentary rock, and basic intrusives. Nearly one hundred tree species are represented. Some eighteen miles of improved woods roads make all parts of these woodlands readily accessible. It serves as an outdoor laboratory for instruction in forestry and allied fields, and as an experimental forest for research in problems of timber growing and in the sciences basic thereto. It is also used to demonstrate methods of silviculture and forest management applicable to the region.

Forestry Sciences Laboratory. The establishment of the Forestry Sciences Laboratory of the United States Forest Service's Southeastern Forest Experiment Station in the Research Triangle Park near Durham provides an unusual opportunity for complementing the research programs of students in the School of Forestry. Specialized research projects in forest entomology, pathology, and soils are currently under way at the laboratory. The research staff of the laboratory is available for consultation, participation in seminars, and service on graduate committees of students in the School of Forestry. Arrangements may also be made for students to conduct certain aspects of their research at the laboratory.

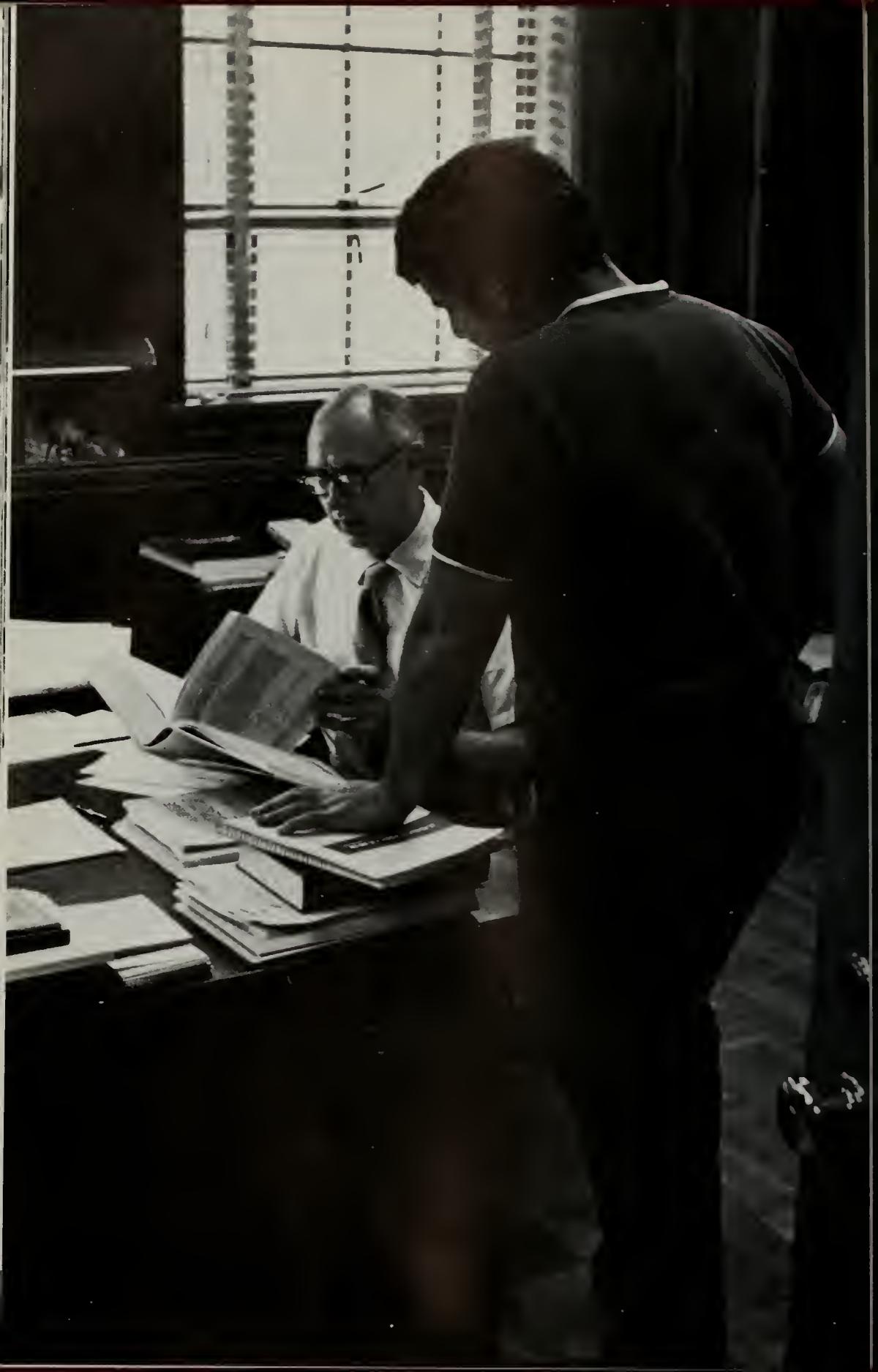
Phytotron. A controlled environment plant growth facility adjoins the Biological Sciences Building. The Duke phytotron contains fifty separately controlled environmental areas. In the chambers and greenhouses it is possible to dissect or reproduce any total environment in the world. Using this procedure, one can study the influence of many environmental factors on the growth processes of trees. The chambers accommodate trees up to six feet tall, the greenhouses even larger plants. The Duke phytotron is one of three such laboratories in the United States.

Duke Environmental Center. The Duke Environmental Center is an interdisciplinary University-wide organization for encouragement and coordination of research and training in environmental subjects. The Center provides



students access to coursework, research, and expertise in all departments of the University and outside agencies involved in environmentally related activities, as well as sponsoring environmental courses and seminars and maintaining an environmental reading and reference room. Students in the School of Forestry may become affiliated with the Environmental Center through working with one of several forestry faculty members who are involved in Center activities.

National Environmental Research Center. The Durham area has the greatest concentration of Environmental Protection Agency offices and activities outside of Washington, D.C. The EPA National Environmental Research Center in the Research Triangle Park is the national center of air pollution research and regulation activities. This facility provides a unique opportunity for cooperative research and advanced training in air pollution and other environmental subjects.



7

Student Life at Duke

Living Accommodations

Housing. Duke University provides residence hall and apartment accommodations for single graduate and professional men and women. Duke University is now building a 500 unit housing facility which will be known as Central Campus Apartments. Planned for completion by the fall semester of 1974, the complex will provide housing for married graduate and professional students, single undergraduate and graduate students, and single and married students in non-degree programs in the Division of Allied Health.

For single students, efficiencies, one-bedroom, and two-bedroom apartments will be fully furnished. The apartments for married students will include a few furnished efficiencies and a number of one, two, and three bedroom units in which the kitchen, living room, and first bedroom will be basically furnished. These apartments are furnished and equipped in such a way as to provide economy and convenience to eligible married students while giving them an opportunity to introduce individual character by using furnishings and accessories they might own or choose to purchase while at Duke.

The monthly rental rates for each type of apartment will be much lower than those offered on the current housing market. For further information on these apartments, married and single students should write:

Manager of Apartments and Property
Duke University
217 Anderson Street
Durham, North Carolina 27706

Until these apartments are available for occupancy, the University will provide assistance to married graduate and professional students in locating suitable housing in Durham where varied types of reasonably priced units

are available. There are several apartment complexes and apartments in older homes; houses for rent and duplexes are available in limited numbers.

The Graduate Center, near the Medical Center, and Town House Apartments house men and women enrolled on a full-time basis in the graduate and professional schools. Town House Apartments are located between East and West Campuses.

The Graduate Center houses 189 male graduate students, 56 female graduate students, and 117 female undergraduate students. Commons facilities on the main floor are shared by men and women.

Students are normally licensed to occupy graduate residential space for the academic year, but for no period less than a semester or specified term.

Duke University operates Town House Apartments primarily for graduate and professional school students. Others are housed in individual apartments if the interests of the University are served. There are 30 two-bedroom units, each furnished for three occupants. Two students occupy the master bedroom with adjoining half-bath, and the third occupies a smaller bedroom. A living room, kitchen, and full bath complete the living arrangement. Additional features are air-conditioning and a swimming pool. The campus bus, serving all parts of the University is accessible to the Town House Apartments.

Rooms in residence halls and spaces in the Town House Apartments or other residential units may be reserved by applicants only if they have been accepted by the graduate or professional schools, and after the required \$50 residential deposit has been paid to the University. The initial residential deposit is required with the application and is held until the room or apartment is vacated. Application forms and detailed information on graduate housing will be mailed when the graduate or professional schools have notified the Department of Housing Management of official acceptance of the student. Single students may express a choice for the type of housing desired. Completed ap-



plications for rooms and apartments are to be returned with the required deposits, to the Department of Housing Management, Duke Station, Duke University, Durham, North Carolina 27706. Assignment priority is established by the date of receipt of completed applications with deposits in this office.

Regulations governing occupancy of rooms and apartments will be provided by the Department of Housing Management at the time application forms are forwarded to accepted students. Occupants within each type of housing are expected to comply with the appropriate regulations.

Detailed information about University housing facilities for single students, and the housing assistance program for married students, will be provided upon request by writing to the above address.

For the cost of housing, see the section on Financial Information.

Dining Service. The dining facilities on the West Campus include two cafeterias with multiple-choice menus, a snack bar, and the Oak Room where full meals and a la carte items are served. In the Graduate Center there is a cafeteria with multiple-choice menus and a coffee lounge where sodas and sandwiches are served.

Due to the large number served in the dining halls, it is not possible to arrange special diets for individual students. Special diets for the sick are served in the infirmary.

Services Available

Medical Care. The aim of the University Health Service is to provide medical care and health advice necessary to help the student enjoy his privilege of being a part of the University community. To serve this purpose, both the University Health Services Clinic and the University Infirmary are available for student health care needs.

The main components of the Health Service include the University Health Services Clinic, located in the Pickens Building on West Campus, and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. Residential staff personnel should be consulted whenever possible for assistance in obtaining emergency treatment.

The facilities of the University Health Services Clinic are available during both regular and summer sessions to all currently enrolled full-time students. The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students.

To secure the benefits of the Student Health Program, a graduate student during the terms or semester in which the illness occurs, must (1) in the Summer session term be registered for at least 1 unit research or 3 units of course work, (2) prior to completing minimum residence requirements, be registered for at least 9 units per semester.

Students are not covered during vacations, and their dependents and members of their family are not covered at any time.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for any and all services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The Student Mental Health Service under the direction of Dr. W. J. Kenneth Rockwell, which is located in the Pickens Rehabilitation Building,

provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve month period. For additional fees a student may obtain coverage for a spouse or spouse and child. Participation in this program is on a waiver basis. The University expects all students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may waive the Duke Plan by signing a statement to this effect. Each full-time student in residence must purchase this student health insurance or sign a waiver before his registration is complete. The Student Accident and Sickness Insurance Policy provides protection 24 hours per day during the full 12-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the policy is from opening day in the fall. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage.

The Duke University Counseling Center. Through the counseling center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. A continuing program of research in the areas of counseling and testing is also carried on by the staff of the center.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with students about their future professional plans. Students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations are far easier to accumulate during the time a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year through the Placement Office for those students who have registered. Copies of academic records are released only with the permission of the individual.

Student Activities

Forestry students new to Duke University are reminded that they are welcome to use such recreational facilities as swimming pools, tennis courts, golf course, and to affiliate with choral, instrumental, drama, and religious groups.

Students are encouraged to maintain broad professional contacts by



participation in the activities of the Society of American Foresters, the Forest Products Research Society, the national honorary scientific society of Sigma Xi, and other societies appropriate to their major field of study.

The social and business events of the Forestry Club provide opportunities for many pleasant extracurricular activities. An active organization of the wives of forestry students, the Forestry Dames, offers a regular schedule for social occasions of interest to this group.

Conduct of Students

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as are currently in effect or, from time to time, are put into effect by the appropriate authorities of the University.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations, or for conduct adjudged unsatisfactory or detrimental to the University.

Visiting Scholars

The libraries and, to the extent practicable, other facilities of Duke University will be made available to faculty members of colleges and universities who wish to spend a period of time on the campus in pursuit of their scholarly interests. No fees will be charged such visitors unless they wish to participate in activities for which a special fee is assessed. Room and board may be arranged for at the regular rate in the dormitories and dining rooms. Dormitory space is usually available during the summer months. Inquiries concerning residence for visiting scholars should be directed to the dean of the Graduate School.



8

Financial Information

Tuition and Fees*

The following table shows the charges collected from all students for the year 1973-74. All charges for each semester are due and payable, unless otherwise specified, at the time of registration and no student is admitted to classes until arrangements have been made with the Bursar of the University for the settlement of such charges. After the day of registration, no refund of tuition will be made except for involuntary withdrawal to enter the armed services or in accordance with established University policy.

Tuition, per semester	\$1250.00
Spring field seminars	15-25
In Absentia Fee, per semester (when applicable)	83.00

Forestry students may obtain admission to all regularly scheduled University athletic contests held on the University grounds during the entire academic year by payment of an athletic fee of \$25.00 per year, plus any federal taxes that may be imposed. This fee is payable in the fall semester.

Audit Fee. If a student registers and pays fees for 12 units or more, he may audit one course without charge. Should he be permitted to audit a second course or should he be registered for less than 12 units the audit fee is \$40.00 per course.

Transcripts. A student may request transcripts of his academic record. A minimum fee of two dollars, payable in advance, is charged for a single copy. A charge of \$.50 will be made for each additional copy of the same order.

*Although these fees are based upon existing charges, they are subject to change.

Debts. No records are released and no student is considered by the faculty as a candidate for a degree until he has settled with the Bursar for all indebtedness.

Living Accommodations

Housing Fee. The charge for each person is a double room for the academic year is \$371 in the Graduate Center. A limited number of single rooms are reserved for returning students.

The fee for Town House Apartments is \$670 for the academic year on the basis of three students to an apartment. Utility charges are included in these fees.

Housing fees are subject to change prior to the 1974-75 academic year. A \$50 deposit is required on all reservations.

For further information on housing facilities, see Living Accommodations in the chapter on Student Life.

Dining Service. The cost of the dining facilities discussed on page 33 will approximate \$700.00, depending on the tastes of the individual.

Motor Vehicles

Each member of the Duke academic community possessing or maintaining a motor vehicle at Duke University is required to register it with the University. Students do so annually at the beginning of the fall semester. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, it must be registered within five calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of \$10.00 for each automobile or \$5.00 for each two-wheeled vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least \$10,000 per person and a \$20,000 per accident for personal injuries, and \$5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

Estimated Expenses for the Academic Year

The following table represents an estimate of a graduate student's basic expenses in the School of Forestry for the year 1973-74. It should be noted, however, that this estimate does not include any allowance for travel, clothing, and other miscellaneous expenses, inasmuch as these costs will vary depending on the needs, habits, and tastes of the individual.

	Low	Moderate	Liberal
Tuition	\$2500.00	\$2500.00	\$2500.00
Room-rent*	371.00	371.00	497.00
Board	650.00	700.00	750.00
Laundry	30.00	40.00	50.00
Books	50.00	65.00	100.00
Athletic Fee (Optional)	25.00	25.00	25.00
Spring field seminars	10.00	10.00	10.00

*In the Graduate Center.



Student Aid

A number of fellowships, scholarships, and assistantships are allocated to the School of Forestry for the encouragement and financial assistance of men and women who offer promise of becoming leaders in the forestry profession. These are awarded to applicants of high character on the basis of scholastic ability as judged by previous educational performance, professional experience, personal references, and the Graduate Record Examination. Holders of the awards will pay tuition and such additional fees as are regularly required.

Fellowships. Stipends range from \$2,300-\$4,000 per academic year. Each recipient must have previously completed work equivalent to that required at Duke University for a master's degree with a major in forestry or in a discipline basic to forestry. He will devote his time to an approved program of study and research in any of the branches of forestry. He is expected to become a candidate for the degree of Doctor of Forestry or Doctor of Philosophy.

Scholarships. Stipends range from \$600-\$3,200 per academic year. Each recipient will normally devote his time to an approved program of study leading to the degree of Master of Forestry, or Master of Science with a major in forestry.

Graduate Assistantships. Graduate assistantships have variable stipends up to \$4,000, depending upon available funds and upon whether granted for the academic year only, or the academic year plus the summer. Each recipient will devote half-time to research or other work of the School of Forestry. He will be permitted to enroll for not more than 24 units in an academic year in an approved program of study, or study and research.

Application for Awards. Any student admitted to the School of Forestry is eligible to apply for a fellowship, a scholarship, or an assistantship. Application for these awards may be made concurrently with the application for admission.

The general procedures and requirements for applying for any financial award in the School of Forestry are outlined below. Applicants should initiate the necessary action early to ensure that the required documents are filed with the dean of the School of Forestry on or before February 1 prior to enrollment.

1. File award application. Form will be supplied by the School of Forestry upon request.

2. Furnish supporting documents as follows: (a) official transcripts of record of all previous college or university credits earned and (b) letters of reference from at least three persons familiar with the applicant's character, scholarship, and professional ability. (Documents offered in support of admission, if so designated, may also serve in support of the application for financial award.)

3. Complete the Aptitude Test of the Graduate Record Examination. Instructions and application for admission to this locally administered examination are available on most college campuses, from the Duke School of Forestry, or by writing the Educational Testing Service, Princeton, New Jersey. Applicants should plan to take this examination in January or earlier.

Notification of awards is made on March 15. In case vacancies occur, completed applications received after February 1 will be considered at a later date.

In every instance where a graduate assistantship, scholarship, or fellowship for the next academic year is offered to an actual or prospective graduate student and accepted before April 1, the recipient may resign his appointment without prejudice prior to that date by notification in writing to the dean. However, an acceptance given or left in force after April 1 obligates him not to accept another appointment without first obtaining formal release from the dean of the School.

Loans

Students who are enrolled as full-time degree candidates and who have satisfactory academic and citizenship records are eligible to apply for student loans.

Champion Paper Foundation Fund. Established in 1971 by a grant of the Champion Paper Foundation in support of the School of Forestry. Forestry students may apply for assistance from this fund through the University Student Loan Office.

University Student Loans. The Duke University Federal Guaranteed Student Loan Program makes it possible for students to borrow from Duke University up to \$2,500 per year at 7 percent interest. Students are entitled to the benefits of the federal guarantee when borrowing individually from banks or certain state agencies. An interest subsidy is available from federal funds for all students who have demonstrated need on the Parents' Confidential Statement for Undergraduates or Graduate and Professional School Financial Aid Services (GAPSFAS) for graduates. The financial aid officer is given considerable flexibility in determining an amount that realistically can be provided by the family. If parents do not wish to submit a Parents' Confidential Statement the loan is still available, but 7 percent interest must be charged.



Repayment begins twelve months after a student completes his education. The loan must be repaid within ten years.

Other Funds. In addition to local loan funds, Duke University participates in the student loan program established under the provisions of the National Defense Education Act of 1958. Repayment of these loan funds normally begins one year after the student terminates full-time study. Interest accrues at the rate of 3 percent per annum commencing one year after termination of full-time study. Upon completion of the period of grace of twelve consecutive months, the ten-year annual repayment period begins, and simple interest on the loan at the rate of 3 percent starts to accrue. At this point the borrower still has one additional year before his first annual payment becomes due. The first annual installment will, therefore, fall due twenty-four months after the borrower has ceased being a full-time student.

Special benefits to those teaching in non-profit schools, colleges, and universities permit a portion of the loan to be cancelled, depending upon the length of teaching service.

Applications and complete details regarding the student loan program may be obtained by writing to the Student Loan Division of Duke University. In approving loan applications, the Student Loan Committee selects those students who, from the standpoint of character, scholastic attainment, personality, and degree of financial need, are deserving of this consideration. All applications for loans should be made before July 1 preceding the academic year in which the student plans to matriculate.



9

Courses of Instruction

General

152. Conserving Natural Resources. Fundamentals of natural resource development, use, management, and protection based on principles of the natural and social sciences. 3 units. Staff

200. Careers in Natural Resources. A weekly seminar which surveys the research and managerial career opportunities in all fields of renewable natural resources. Required of students in Academic-Forestry program. No credit. Staff

Forest Biology

DENDROLOGY AND WOOD ANATOMY

206. Anatomy of Woody Plants. Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations and for study of micro and ultra structures with light and electron microscopy. Relationship of micro structures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. 4 units. Philpott

241. Dendrology. Nomenclature, classification, and identification of woody plants, with special reference to the tree species indigenous to southeastern United States and other important forest regions of temperate North America. Prerequisites: Biology 1-2 or equivalent. 3 units. White

292. Microtechnique of Woody Tissue. Preparation of wood for microscopic study including sectioning, staining, and mounting techniques; elementary photomicrography. Prerequisites: Forestry 241 and 206 or equivalents and approval of instructor. (Offered alternate years on sufficient demand.) 3 units. Philpott

Related courses in other departments include—Botany: Anatomy, Systematics, Physiology; Chemistry: Organic Chemistry; Civil Engineering: Mechanical Behavior of Materials.

ECOLOGY

243. Natural Resource Ecology. An introduction to modern ecology with emphasis on natural resource management. Emphasis put on the ecosystem as the basic unit of management. Prerequisite: consent of instructor. 3 units. Wuenscher

340. Ecology and Land Use Planning. Consideration of the properties and processes of the natural environment as they relate to land use. Exploration of the biological, economic, legal, and social aspects of the application of ecological principles to the land use planning process. Prerequisites: Forestry 341 and consent of instructor. (Not offered in 1973-74.) 3 units. Wuenscher

341. Ecological Principles in Environmental Management. Discussion of the application of ecological principles to environmental manipulation. Methods of planning and managing human use of ecosystems while avoiding environmental deterioration. Stress put on the biological viewpoint. Prerequisites: general ecology and Forestry 243 or other substantive coursework in ecology. 3 units. Wuenscher

346. Seminar in Environmental Policy. Discussion of the political, legal, and socioeconomic aspects of public and private action in environmental quality control and management. Prerequisites: Forestry 269 and 341 or their equivalents and consent of instructor. 1 unit. Convery and Wuenscher

347, 348. Natural Resource Ecology—Environmental Management Seminar. Discussion of current ecological and environmental problems and research topics related to the management of natural resources. 1 unit. Knoerr and Wuenscher

354. Quantitative Analysis of Ecological and Environmental Systems. Study of quantitative methods for describing forest ecosystems. Analysis of characteristics and dynamic behavior of biological populations; development and evaluation of mathematical models for ecological, physiological, and environmental systems. Simulation techniques for ecosystem analysis will be considered. Prerequisites: Forestry 204, 243, 253, and 353. 3 units. Yandle and Staff

Related courses in other departments include—Botany: Ecology, Plant-Water Relations, Community Analysis and Classification, Principles of Plant Distribution, The Environment, Vegetation of North America, Evolution; Zoology: Animal Behavior, Vertebrate Zoology.

PHYSIOLOGY AND BIOCHEMISTRY

201. Tree Physiology. A general survey of the major physiological processes in trees and other plants, including food synthesis, growth, and water relations. Special project and term paper required. Lectures, laboratories, and readings. Prerequisite: permission of instructor. (Listed also as Botany 251.) 3 units. Hellmers

205. Tree Growth and Development. Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. 3 units. Barnes

207. Chemistry of Wood Tissues. Composition of wood at the elemental, molecular, and macromolecular levels, both in woody plants and in processed woods. Distribution and properties of main components and methods of analysis. Prerequisite: organic chemistry or consent of instructor. 3 units. Barnes

208. Physiology of Wood Formation. Processes involved in the growth and development of woody tissues, including internal control mechanisms and effects of environmental stresses on structure and composition. Prerequisites: Forestry 201 and 241 or equivalents. 3 units. Barnes

305. Forest Tree Biochemistry. Study of the biological synthesis, function, and degradation of the main biochemical constituents of trees. Emphasis on cellulose and other cell-wall polysaccharides, lignins, terpenes, and phenolics and other extractives. Prerequisites: Forestry 201 and a course in biochemistry. 3 units. Barnes

Related courses in other departments include—Botany: Anatomy, Plant Metabolism, Plant-Water Relations, Physiology of Growth and Development; Biochemistry: Introductory Biochemistry, Chemistry of Natural Products; Chemistry: Organic Chemistry, Chemical Instrumentation.

PATHOLOGY

222. Biology of Forest Insects and Diseases. Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work, with emphasis on identification and interpretation of forest and wood degradation. 4 units. Anderson and Stambaugh

223. Forest Pathology. Survey of major diseases of North American forests and their timbers, with emphasis on current literature. Field and laboratory study in diagnosis and infection biology. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 4 units. Stambaugh

321. Phytopathological Technique in Forestry. Fundamentals of phytopathology as applied to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: Forestry 223 or equivalent. 4 units. Stambaugh

322. Microbiology of Forest Soils. Qualitative and quantitative characterization of the microbial populations of forest soils, with emphasis on rhizosphere interactions in root pathogenesis and mycorrhizal development; epidemiology of root diseases of trees; principles of control. Prerequisite: Consent of instructor; mycology or bacteriology is recommended. 3 units. Stambaugh

385. Seminar in Forest Protection. Discussion of current problems in entomology and pathology and evaluation of topical research for protection and control application in forest resource management. Prerequisites: Forestry 223 and 230. 1 unit. Anderson and Stambaugh

Related courses in other departments include—Botany: Mycology, Plant-Water Relations, Physiology of Growth and Development, Cytology, Genetics; Chemistry: Organic Chemistry; Zoology: Biological Nucleonics; Biochemistry: Introductory Biochemistry.

ENTOMOLOGY

222. Biology of Forest Insects and Diseases. (See description under Pathology above.)

225. Chemical Aspects of Forest Protection. Chemical aspects of organisms attacking trees and of the materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: Forestry 222. 3 units. Barnes

230. Forest Entomology. Identification, biology, and control of insects

that cause damage to trees and wood products. Emphasis of diagnosis is on the characteristics of the damage and the stages of the insects responsible. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 3 units. Anderson

233. General Entomology. Principles of morphology, metamorphosis, and taxonomy of insects. Prerequisites: one course in entomology or zoology, or consent of the instructor. (Offered alternate years on sufficient demand.) 4 units. Anderson

331. Toxicology of Insecticides. Study of the physical, chemical, and biological properties of materials used to destroy insects. Formulation, toxicology, and insect physiology as related to insecticide action are emphasized. Prerequisite: one course in entomology; organic chemistry is recommended. (Offered alternate years on sufficient demand.) 3 units. Anderson

332. Ecology of Forest Insects. The influence of environmental factors on the vital processes of insects, with emphasis on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology, or consent of the instructor. 3 units; 4 units with laboratory. Anderson

335. Entomological Research Techniques. Problem analyses, scientific writing, and laboratory and field research methods which are especially applicable to entomological problems. 1 unit. Anderson

385. Seminar in Forest Protection. (See description under Pathology above.)

Related courses in other departments include—Zoology: Ecology, Systematic Zoology, Radiation Biology, Biological Nucleonics, Cellular Physiology, Invertebrate Embryology, Genetics; Chemistry: Organic Chemistry; Biochemistry: Introductory Biochemistry; Botany: Bacteriology; Microbiology and Immunology: Microbiology.

Environmental Science

347, 348. Natural Resource Ecology—Environmental Management Seminar. (See description under Ecology above.)

SOILS

261. Soils and Forest Resources. Origin, development, and classification of soils, with special emphasis on those developed in humid climates; morphological, physical and chemical properties of soils in relation to growth of trees; effect of forests on soils. Prerequisites: Chemistry 1 and 2 and Physics 1, or equivalents; physical geology, mineralogy, petrology, and analytical chemistry are also desirable. 3 units. Ralston

362. Forest Soil Physics. Analysis of the physical properties of soil related to the growth and development of forest trees. Consideration is given to the significance of soil moisture, temperature, aeration, and structural characteristics in the analysis of forest growth relationships. Prerequisite: Forestry 261. (Offered on sufficient demand.) 3 units. Ralston

364. Soil Classification and Mapping. Classification of soils as natural bodies. Mapping of soils, land-use classes and forest-site classes; field study will be made of soil in either the coastal plain or mountains. Prerequisite: Forestry 261. 3 units. Ralston

366. Forest Soil Fertility. The relationships of soil fertility factors in the growth of forest trees. Emphasis is placed on the analysis of soil factors related to the mineral nutrition of trees. Prerequisite: Forestry 261; analytical chemistry is recommended. (Offered on sufficient demand.) 3 units. Ralston

Related courses in other departments include—Botany: Plant-Water Relations, Physiology of Growth and Development; Biochemistry: Introductory Biochemistry; Chemistry: Chemical Instrumentation, Elements of Theoretical Chemistry; Geology: Sedimentary Minerals.

METEOROLOGY

203. General Meteorology. A general introduction to the science of meteorology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of atmospheric thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. 3 units. Vukovich

204. Microclimatology. Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. 3 units. Knoerr

215. Air Pollution Meteorology. The theory of transport and diffusion of air pollutants and its application to practical problems and computations involving both single sources and multiple sources, including urban communities; modeling of transport and diffusion, both in wind tunnels and computers; stack design from the meteorological point of view; the organization of meteorological networks and field studies; the measurement, monitoring, and equipment requirements of pertinent meteorological parameters; air pollution climatology; meteorological management of air pollution. Prerequisite: Forestry 203 or equivalent. (Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty from N.C. State University). 3 units. Staff

217. Environmental Instrumentation. Consideration of the physical basis for measuring parameters of natural and controlled environments. Properties and effective utilization of contemporary electronic measurement and data acquisition systems, including transducers, signal conditioners, and analog and digital recorders. Methods for obtaining and processing computer compatible records. Precision measurement and calibration techniques with primary and secondary laboratory standards. Two lectures and three laboratory hours per week. Prerequisite: consent of the instructor. Students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. 4 units. Knoerr

304. Atmospheric Turbulence and Diffusion. Bulk and molecular aspects of atmospheric turbulence; Navier-Stokes equations and the Reynold's stresses; mixing-length and statistical turbulence theories; similarity hypotheses; turbulent transfer and diffusion in adiabatic and diabatic atmospheres; characteristics of turbulence in various scales of motion from the planetary to sub-inertial range. Prerequisites: Forestry 203 and differential equations, or consent of instructor. 3 units. (Offered on sufficient demand.) Vukovich

306. Dynamics of Local Atmospheric Motion. Characteristics of atmospheric motion in the 100 m to 100 km scale. Analytic development from hydrodynamic and thermodynamic equations, incorporating appropriate scale-forcing functions of heating and terrain roughness. Theory and characteristics of land and sea breezes, mountain and valley breezes, mountain waves, and local

modification of large scale atmospheric motion. Prerequisites: Forestry 203 and differential equations, or consent of instructor. 3 units. (Offered on sufficient demand.) Vukovich

344. Micrometeorology. Physics of the earth's surface environment, with emphasis on plant and animal microclimates; budgets of mass, momentum, and energy; vertical structure of wind, temperature, water vapor, and carbon-dioxide in relation to exchange processes within the biosphere; local circulation and eddy diffusion; principles of micrometeorological measurement. Prerequisites: Forestry 203, or equivalent, and calculus. 4 units. (Offered on sufficient demand.) Knoerr

Related courses in other departments include—Mechanical Engineering: Fluid Mechanics, Thermodynamics, Heat Transfer, Transport Phenomena, Boundary Layer Theory; Mathematics: Applied Mechanical Analysis, Numerical Analysis; Chemistry: Physical Chemistry, Chemical Instrumentation; Botany: Ecology, Plant-Water Relations.

HYDROLOGY

216. Watershed Hydrology. Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of stream. Techniques and research methods used to control the hydrologic cycle, water quality, and water yield on wild lands. 3 units. Hellmers

342. Hydrologic Processes. Physical processes of the hydrologic cycle, with emphasis on those processes which can be modified or controlled by watershed management. 3 units. (Offered on sufficient demand.) Knoerr

Related courses in other departments include—Civil Engineering: Hydrology, Incompressible Fluid Flow, Mechanics of Fluids; Mechanical Engineering: Transport; Chemistry: Physical Chemistry, Chemical Instrumentation; Botany: Ecology, Plant-Water Relations.

Resource Economics and Management

ECONOMICS AND POLICY

269. Resource Economics and Policy. Development and critical review of concepts useful in understanding and evaluating the distribution of natural resource use over time in terms of the relations between technological knowledge, group and individual behavior, and social institutions. 3 units. Convery

270. Economics of Forestry. Development of the principles of economics useful in the analysis of the past, present, and prospective supply and demand situations for forestry goods and services; problems of the economics of the firm and industry, basic and peculiar to forestry, with special attention to the time dimensions of value; the role of forestry in the general economy, including attention to relevant institutional factors. Prerequisite: Forestry 269 or equivalent. 3 units. Convery

271. Financial Management. Analysis of the problems of management of the financial affairs of the firm: working capital, long-term capital needs, including the development of an optimal capital structure, with attention to tax problems. 3 units. Joerg

272. Business Policy. An integrating course where, through analysis of case problems from the top management viewpoint, the student is given practice in arriving at effective courses of action for the solution of business problems. 3 units. Joerg

273. Economics and Environmental Quality. Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. 3 units. Convery

277. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: an advanced-level course in non-market decision-making or Forestry 378 or its equivalent. 1 unit. Convery

378. Seminar in Forest Economics. Examination and discussion of the application of economic concepts in forestry; the potential contribution of economic analysis to private and public forest management; current research in forest economics. Prerequisites: Forestry 270 or consent of the instructor; advanced courses in economics and economic theory are desirable. 2 units. Convery

Related courses in other departments include—Economics: Economic Theory, History, and Systems; Economic Development, Planning, and Fluctuations; Economic Statistics; Monetary and Fiscal Theory and Institutions; International Economics; Manpower, Labor, and Population; Industrial Organization and Public Policy; Business Administration: Business Finance, Marketing, and Accounting.

MANAGEMENT

210. Forest Utilization. Introduction to utilization in the managed forest and the principal wood-using industries. A one-week field seminar is an integral part of the course. 2 units. Yandle

244. Theory and Practice of Silviculture. Principles governing establishment, treatment, and control of forest stands; natural and artificial methods of reproduction, intermediate cuttings, and cultural operations, with emphasis on the principal forest types of temperate North America. Field practice in silvicultural operations and study of managed stands. Prerequisite: Forestry 243 or equivalent. 3 units. White

248. Forest Regeneration. The fundamentals and application of forest tree improvement, nursery operations, and site-improvement techniques to the regeneration of forest stands by artificial and natural means. 3 units. Chaiken and White

256. Forest Measurements. Application of plane-surveying technique to the measurement of land area, topography, and timber type; measurement of volume and growth of forest trees and stands; measurement of forest products. 4 units. White

281. Forest Management. Principles of organizing forest properties for systematic management; use of data obtained in surveys and inventories; principles of forest regulation, including a study of normal and actual forests, rotations, cutting cycles, and methods of regulating the cut in even-aged and all-aged forests for sustained yield; introduction to the preparation of preliminary forest management plans. 3 units. Chaiken

283. Fire Behavior and Use. Impact of destructive agencies upon forests;

principles of combustion, fire behavior, danger measurement, and suppression; use of fire in forest management. 2 units. Chaiken

289. Interpretation of Aerial Photographs. Principles of aerial photography and remote sensing as applied to forest administration, vegetation mapping, forest mensuration, and insect and disease surveys. Corequisite: Forestry 281 or equivalent. 2 units. Chaiken

382. Legal Aspects of Forestry. A seminar on certain state and federal laws pertinent to the management of forests: land ownership, trespass, public liability, timber contracts, labor relations, and use of pesticides. 1 unit. Chaiken

386. Seminar in Forest Management. Examination and analysis of techniques employed in the management of industrial and public forests, particularly in the South; discussion of problems of large scale intensive forest management. Prerequisites: Forestry 244, 281, and 377 or equivalent. 1 unit. Chaiken

Related courses in other departments include—Business Administration: Theory of Firm, Organization Theory, Information Systems, The Firm in Society; Political Science: Public Administration; Sociology: Social Stratification, Industrial Sociology.

Statistics and Operations Research

250. Biometry. Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision-making with experimental data. 3 units. Yandle

251. Theory and Methods for Sampling Biological Populations. Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: Forestry 250 or consent of instructor. 3 units. Yandle

253. Computer Science in Natural Resources. Components and organization of a computer system; automatic programming languages; storage and retrieval systems (SAS); equation fitting by iteration and least-squares methods; graphical techniques. 3 units. Staff

258. Operations Research. Mathematical model formulation and development of techniques to aid decision-making in problems of natural resource allocation and use. Includes the theory and techniques of inventory control, equipment replacement planning, queuing theory, competitive strategies, allocation, sequencing, and dynamic programming. Consideration is given to both deterministic and nondeterministic models. 3 units. Yandle

352. Theory and Applications of Linear Statistical Models. Theoretical development of the general linear statistical model, together with extensions to accommodate linear approximation of non-linear cases. Curve-fitting techniques are developed, with emphasis on applications to natural phenomena. Prerequisite: consent of the instructor. 3 units. Staff

353. Design and Analysis of Experiments. Extension of the theory of estimation and testing for general linear models to include the less than full rank case. Experimental design models such as factorial and incomplete

block models and developed as special cases of the general theory. Emphasis is placed on field and laboratory designs, together with appropriate computerized analysis techniques. Prerequisite: Forestry 352. 3 units. Staff

354. Quantitative Analysis of Ecological and Environmental Systems. (See description under Ecology above.)

Related courses in other departments include—Mathematics: Calculus, Numerical Analysis, Complex Analysis, Non-parametric Statistics, Probability, Applied Mathematical Statistics, Stochastic Processes, Multivariate Statistics; Economics: Econometrics, Quantitative Analysis.

Special Studies and Research

299. Special Studies in Forestry. Work on the senior-graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. Staff

301, 302. Advanced Studies in Forestry. Work on the advanced graduate level to meet the needs of individual students is offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. Staff

357, 358. Research in Forestry. Students with adequate training may undertake special research problems under direction of members of the faculty in the following branches of forestry and related natural resources. Credits to be arranged. Staff

1. Forest Ecology. Prerequisite: Forestry 243 or equivalent. Wuenscher
2. Forest Soils. Prerequisite: Forestry 261 or equivalent. Rolston
3. Silviculture. Prerequisites: Forestry 243 and 244 or equivalents. White
4. Forest Management. Prerequisite: Forestry 281 or equivalent. Choiken
5. Forest Economics. Prerequisite: Forestry 270 or equivalent. Convery
6. Wood Anatomy and Properties. Prerequisites: Forestry 241 and 206 or equivalents. Philpott
7. Forest Measurement and Biometry. Prerequisites: Forestry 250 and 352 or equivalents. Stoff
8. Forest Entomology. Prerequisite: Forestry 230 or equivalent. Anderson
9. Forest Operations Research. Prerequisite: consent of instructor. Yonelle
10. Dendrology. Prerequisite: Forestry 241 or equivalent. White
11. Forest-Tree Physiology. Prerequisites: plant physiology and plant or forest ecology. Hellmers and Bornes
12. Forest Pathology. Prerequisites: plant physiology and Forestry 223 or equivalents. Stombough
13. Forest Meteorology and Hydrology. Prerequisites: Forestry 203, 342, or equivalents. Knoerr
14. Forest Biochemistry. Prerequisites: plant physiology and organic chemistry. Bornes

368. Field Seminars. Field studies, consultations, and visits to areas of interest during spring vacation period, or at other times, in the several branches of forestry and related natural resources listed under Forestry 357, 358. Credits to be arranged. Staff

Numerical Listing of Courses

152. Conserving Natural Resources. 3 units
200. Careers in Natural Resources. No credit
201. Tree Physiology. 3 units
203. General Meteorology. 3 units
204. Microclimatology. 3 units
205. Tree Growth and Development. 3 units
206. Anatomy of Woody Plants. 4 units

- 207. Chemistry of Woody Tissues. 3 units
- 208. Physiology of Wood Formation. 3 units
- 210. Forest Utilization. 2 units
- 215. Air Pollution Meteorology. 3 units
- 216. Watershed Hydrology. 3 units
- 217. Environmental Instrumentation. 4 units
- 222. Biology of Forest Insects and Diseases. 4 units
- 223. Forest Pathology. 4 units
- 225. Chemical Aspects of Forest Protection. 3 units
- 230. Forest Entomology. 3 units
- 233. General Entomology. 4 units
- 241. Dendrology. 3 units
- 243. Natural Resource Ecology. 3 units
- 244. Theory and Practice of Silviculture. 3 units
- 248. Forest Regeneration. 3 units
- 250. Biometry. 3 units
- 251. Theory and Methods for Sampling Biological Populations. 3 units
- 253. Computer Science in Natural Resources. 3 units
- 256. Forest Measurements. 4 units
- 258. Operations Research. 3 units
- 261. Soils and Forest Resources. 3 units
- 269. Resource Economics and Policy. 3 units
- 270. Economics of Forestry. 3 units
- 271. Financial Management. 3 units
- 272. Business Policy. 3 units
- 273. Economics and Environmental Quality. 3 units
- 277. Seminar in Natural Resource Allocation and Efficiency. 1 unit
- 281. Forest Management. 3 units
- 283. Fire Behavior and Use. 2 units
- 289. Interpretation of Aerial Photographs. 2 units
- 292. Microtechnique of Woody Tissue. 3 units
- 299. Special Studies in Forestry. Credits to be arranged
- 301-302. Advanced Studies in Forestry. Credits to be arranged
- 304. Atmospheric Turbulence and Diffusion. 3 units
- 305. Forest Tree Biochemistry. 3 units
- 306. Dynamics of Local Atmospheric Motion. 3 units
- 321. Phytopathological Technique in Forestry. 4 units
- 322. Microbiology of Forest Soils. 3 units
- 331. Toxicology of Insecticides. 3 units
- 332. Ecology of Forest Insects. 3 units, 4 units with laboratory
- 335. Entomological Research Techniques. 1 unit
- 340. Ecology and Land Use Planning. 3 units
- 341. Ecological Principles in Environmental Management. 3 units
- 342. Hydrologic Process. 3 units
- 344. Micrometeorology. 4 units
- 346. Seminar in Environmental Policy. 1 unit
- 347-348. Natural Resource Ecology—Environmental Management Seminar. 1 unit
- 352. Theory and Applications of Linear Statistical Models. 3 units
- 353. Design and Analysis of Experiments. 3 units
- 354. Quantitative Analysis of Ecological and Environmental Systems. 3 units
- 357-358. Research in Forestry. Credits to be arranged
- 362. Forest Soil Physics. 3 units
- 364. Soil Classification and Mapping. 3 units
- 366. Forest Soil Fertility. 3 units
- 368. Field Seminars. Credits to be arranged
- 378. Seminar in Forest Economics. 2 units
- 382. Legal Aspects of Forestry. 1 unit
- 385. Seminar in Forest Protection. 1 unit
- 386. Seminar in Forest Management. 1 unit

Appendix

ENROLLMENT

Registered for the Master of Forestry Degree

Allen, David Leslie (B.Sc., University of Louisville). Louisville, Kentucky
Austin, John Towneley (B.S., Furman University). High Point, North Carolina
Bacon, David Gardner (B.A., Duke University). Washington, D. C.
Black, Michael Lee (B.B.A., Ohio University). Parkersburg, West Virginia
Booser, Joanna (B.A., Swarthmore College). Middletown, Pennsylvania
Boyd, Patrick William (Kent State University). Falls Church, Virginia
Broili, Robert Thayer (B.A., University of North Carolina). Raleigh, North Carolina
Brosius, Chad Dayton (Elizabethtown College). Telford, Pennsylvania
Butler, Elizabeth Ann (B.S., Duke University). Colorado Springs, Colorado
Cline, George Richard (B.S., Davis and Elkins College). Aliquippa, Pennsylvania
Dull, Charles Walter (B.A., Bridgewater College). Alexandria, Virginia
Ellsworth, Burton Leslie (B.S., Elizabethtown College). Myerstown, Pennsylvania
Eppley, Robert Francis, Jr. (Elizabethtown College). Davidsville, Pennsylvania
Everest, Raymond John (Guilford College). Winston-Salem, North Carolina
Fish, Lincoln Curtis (Lycoming College). Needham, Massachusetts
Fleming, John Edwin (B.A., Gettysburg College). Penfield, New York
Fraedrich, Bruce Robert (Newberry College). Oceanside, New York
Geyer, Paul Bennett (B.A., Gettysburg College). Gettysburg, Pennsylvania
Ghent, John Hennessey (Catawba College). Alexandria, Virginia
Globig, Jonathan Frederick (B.A., Johns Hopkins University). St. Louis, Missouri
Graham, William Alexander II (A.B.; J.D., University of North Carolina). Durham, North Carolina
Hamilton, Rickey Allen (B.A., Lycoming College). Carlisle, Pennsylvania
Hartlage, James Lee (Marshall University). Portsmouth, Ohio
Hermann, Gary Bruce (B.S., Ohio University). Denville, New Jersey
Hooton, John Joseph (B.A., Auburn University). Chattanooga, Tennessee
Howard, Theodore Edward (B.S., University of Maine). Dartmouth, Massachusetts
Howard, Theodore Samuel (Lincoln Memorial University). Lebanon, Ohio
Johansen, John Ramsey (Elizabethtown College). Ridgewood, New Jersey
Johnson, Charles Thomas (B.A., Thiel College). Montgomery, Pennsylvania
Johnson, Edward Leonard (Gettysburg College). Springfield, Pennsylvania
Jolley, Robert Melvin, Jr. (B.A., Catawba College). Baltimore, Maryland
Keepers, Gene Norman (B.S., Baylor University). Houston, Texas
Kelley, Robert Reed (B.A., Colorado College). Wheat Ridge, Colorado
Kendall, John Rothermel (B.S., Pennsylvania State University). Reading, Pennsylvania
Kerr, Leigh Robinson (Mercer University). Ft. Lauderdale, Florida
King, Larry George (B.Sc., Albion College). Ft. Wayne, Indiana
Klein, Robert Jay (B.A., Brandeis University). Jacksonville, Florida
Kulick, Sue Ann (Wittenberg University). Columbus, Ohio
Leatherman, David Allen (B.S., Marietta College). Columbus, Ohio
MacComb, Louise Leslie (B.A., Southern Methodist University). Houston, Texas
Manandhar, Prahlad Krishna (I.Sc., Central Hindu College; B.Sc., Tri-chandra College; A.I.F.C., Indian Forestry College). Kathmandu, Nepal
Mandraccchia, Anthony Liborio (B.A., College of the Holy Cross). Manhasset, New York
McNamara, Edward Paul (Duke University). Oxon Hill, Maryland
Mead, Delbert Ray (B.S., Albright College). Montrose, Pennsylvania
Minis, Henry Philip, Jr. (B.S., University of North Carolina). Chilmark, Massachusetts
Moul, Robert Lawrence (B.S., Elizabethtown College). Spring Grove, Pennsylvania
Nehnevauska, Peter Bruce (Wittenburg University). Pittsburgh, Pennsylvania
Nelson, Larry Robert (Ohio University). Canton, Ohio
Nettleton, Wesley Allen (B.S., Stetson University). Guilford, Connecticut
Nguyen-Van-Phu (For. Eng., College of Forestry, Viet Nam). Saigon, Viet Nam
Noel, Forrest Dale (Ohio University). Portsmouth, Ohio
Norris, Jeffrey Lee (Ohio University). Gloucester, Ohio
Olson, Christopher Peter (B.S., University of Maine). Westwood, Massachusetts
Peiffer, Gary Richard (B.S., Elizabethtown College). Locust Valley, New York
Pfortner, Raymond George (B.S., Yale University). Woodcliff Lake, New Jersey
Prather, Lewis Douglas, Jr. (Wake Forest University). Columbia, South Carolina
Pritchard, David Thomas (B.S., Duke University). Waynesburg, Pennsylvania
Rabbets, John Nicholas (Moravian College). Glenolden, Pennsylvania
Rathburn, Francis Arthur (High Point College). Pompton Plains, New Jersey

Ross, Danny Allen (Lincoln Memorial University). West Canton, Ohio
Schleifarth, Robert Armin (B.S., University of Idaho). St. Louis, Missouri
Schlenker, James Wallace (B.S., Muhlenberg College). Silverdale, Pennsylvania
Schnieberger, Noel Frank (Wittenberg University). Chatham, New Jersey
Schweitzer, Daniel Jay (B.A., Denison University). Canton, Ohio
Seiler, Gary Iorwerth (B.S., Albright College). Reading, Pennsylvania
Shasby, Mark Baldwin (Miami University). Youngstown, Ohio
Shay, Patrick Fred (B.S., Gettysburg College). Lebanon, Pennsylvania
Sheiburn, Victor Balmer (Duke University). Stamford, Connecticut
Skove, David James (College of William and Mary). Williamsburg, Virginia
Smith, Chandler Craig (B.A., Duke University). Columbia, Missouri
Smith, John Winthrop (B.S., Furman University). Kingsport, Tennessee
Steffy, Brian Dwight (Randolph-Macon College). Ephrata, Pennsylvania
Stoddard, Robert Hamilton (B.A., Vassar College). Sparta, New Jersey
Stokes, Harry Currier (B.A., Duke University). Princeton, New Jersey
Stuart, John Jarrell (Catawba College). Cherry Hill, New Jersey
Thomas, Wendell Bruce (B.A., Pomona College). LaMesa, California
Thompson, Edward Claude (B.S., Duke University). Silver Spring, Maryland
Tolley, Richard Treherne (A.B., Duke University). Hyattsville, Maryland
Twardus, Daniel Bruce (B.A., Gettysburg College). Marlboro, New Jersey
Vasievich, Joseph Michael (Franklin and Marshall College). Easton, Pennsylvania
Weaver, David Forrest (The College of William and Mary). Arlington, Virginia
Wharton, Eric Howard (Lycoming College). Malverne, Pennsylvania
Whelan, Juliann (B.A., Dunbarton College). Yardley, Pennsylvania
Whitenight, Donald Keith (A.S., York College of Pennsylvania; B.S., West Virginia University).
Danville, Pennsylvania
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Willett, Geoffrey Seymour (Gettysburg College). Glen Rock, New Jersey
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Douglass, Ross Swarens (B.S., North Carolina State University; M.F., Duke University). Raleigh,
North Carolina

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Baldwin, Virgil Clark (B.S., University of Utah; M.S., Colorado State University). Salt Lake City,
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Barnard, Edward Livingston (B.S., University of Vermont; M.S., Duke University). Shoreham,
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Asheville, North Carolina
Duda, Alfred Michael (B.S., Boston College). Pittsfield, Massachusetts
Lorimer, Craig Gordon (B.A., Colby College). North Windham, Maine
Meadors, Merewyn Davis (B.S.; B.A., Morris Harvey College; M.S., Marshall University). St.
Albans, West Virginia
Methven, Ian Robert (B.Sc.F., University of New Brunswick). Fredericton, New Brunswick,
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Morgan, William Floyd, II (B.S., University of Illinois; M.F., Duke University). Normal, Illinois
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Olmsted, Ingrid Christene (B.S., Brandeis University). Action, Massachusetts

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Robbins, Mary Kathryn (B.A., Denison University). Westport, Connecticut
Schabel, Hans Georg (B.S.; M.S., University of Freiburg). Honigwiesenstr, Germany
Sigmon, John Thomas (A.B., Duke University). Charlotte, North Carolina

DEGREES CONFERRED 1972-73

Master of Forestry

Eugene Clark Boli
Philip Gregory Cannon
Jeffrey Odlin Cook
William Harrison Dodd, Jr.
Ethan Victor Howard III
Bruce Wentland Kauffman
Dan Burton Kincaid
James Neal McNaull

Nicholas S. Metes
Robert David Owston
Mark David Peterson
James Moore Starrett
Carol Frances Stewart
Terrence L. Tait
James Steen Traylor

Master of Science

Edward Livingston Barnard

Doctor of Philosophy

Jan Christopher Harms (B.S., University of Idaho; M.F., Duke University). Dissertation: "Networks and Decomposed Linear Programming for Scheduling Forest Production."

Eugene Shoulders (B.S.F., West Virginia University; M.F., Louisiana State University). Dissertation: "Rate of Nutrient Uptake by Slash Pine as a Function of Environmental Factors."

Herbert Percival Sims (B.S.F., University of British Columbia; M.S., Yale University). Dissertation: "Some Ecological Effects of Prescribed Burning on Cut-Over Jack Pine (*Pinus banksiana* Lamb.) Sites, Southeastern Manitoba."

MAP OF DUKE UNIVERSITY

East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
D	Union Building
E	Faculty Apartments
F	Art Museum Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building
H	School of Medicine
I	Hospital Main Entrance
J	Gerontology, D & T
K	Clinical Research
L	Duke Hospital
M	Sociology Psychology
N	Social Sciences
O	Allen Building
P	Krigo Quadrangle
Q	Few Quadrangle
R	Craven Quadrangle
S	Wannamaker Hall
T	Crowell Quadrangle
U	Clock Tower Court
V	Indoor Stadium
W	Medical Research
X	Physics Building
Y	Gross Chemical Laboratory
Z	Plant Environment
AA	Nanaline H. Duke Medical Sciences Building
BB	Warehouse, Shop
CC	Bell Building
DD	Hanes House
EE	School of Nursing
FF	Hanes House Annex
GG	Pickens Rehabilitation Center
HH	Graduate Center
II	Alumni House
JJ	Commonwealth Studies Center
KK	Personnel Office
LL	International House
MM	Personnel Office
NN	Education Improvement Program
OO	A Better Chance Program
PP	International Studies Center
QQ	Campus Stores Office
RR	Office of Institutional Advancement
SS	Information Services
TT	Visitors Bureau
UU	Admissions Office
VV	Office of Institutional Advancement
WW	Edens Quadrangle
XX	Wade Stadium





A stylized illustration of a stained glass window divided into three panes. The left pane shows a white building with a gabled roof and arched windows. The middle pane contains a cluster of white flowers. The right pane depicts a classical building with a pediment and columns.

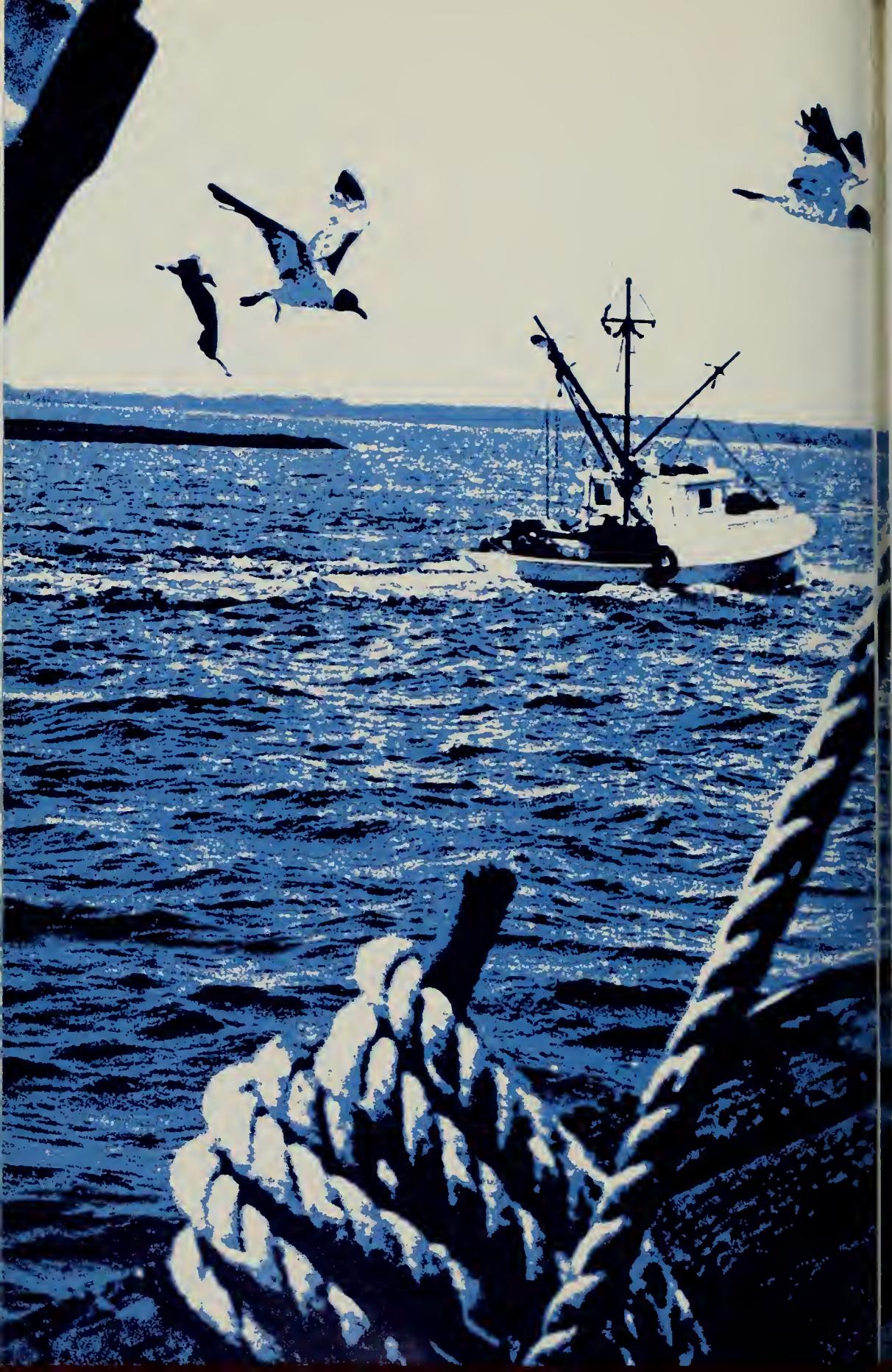
BULLETIN of Duke University

1974

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MARINE LABORATORY



**Bulletin of
Duke University**

Marine Laboratory

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Contents

1 General Information	1
2 Resources for Study	3
Flora and Fauna	3
Research Interests	3
Research Facilities	6
3 Financial Information	9
Tuition	9
Research Space	9
Living Accommodations	10
Dining Facilities	11
Boat Rentals	12
Other Financial Information	13
Awards	13
4 Admission	15
5 Courses of Instruction	17
First Summer Term	17
Second Summer Term	19
Third Summer Term	19
Spring Semester—Undergraduate Program	20
6 Seminars	23
7 Publications	29
Appendix	36
Application Form—Summer Sessions	41
Application Form—Undergraduate Program	43



1

General Information

The Laboratory

Through the efforts of Dr. A. S. Pearse, the Duke University Marine Laboratory was founded in 1938 on Pivers Island near the town of Beaufort, North Carolina. It was established initially to offer teacher training at the senior-graduate level, but research soon became an integral part of the program. Studies are currently being conducted in the fields of ecology, systematics, physiology, embryology, mycology, algology, and biological, chemical, geological, and physical oceanography. In addition to the graduate program, a newly established interdisciplinary program in the marine sciences now makes it possible for qualified undergraduates to spend the spring semester, 1974, at the Laboratory.

The Duke University Marine Laboratory presently occupies fifteen acres of the southern portion of Pivers Island; the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, Center for Menhaden Research encompasses the remainder of the island.

The physical plant consists of nineteen buildings including four dormitories, a large dining hall, one residence, boathouse, storehouse for ship's gear, classroom laboratories, and six research buildings. The research laboratories and two dormitories are heated and air-conditioned thereby providing favorable conditions for year-round research.

Pivers Island is only 150 yards across the channel from the town of Beaufort. A bridge leads to U.S. Highway 70, so the Island is readily accessible by automobile. The only direct means of public transportation to Beaufort is by bus. The closest airport (served by Piedmont Airlines) is in New Bern, North Carolina, a distance of forty miles from Beaufort. Upon arrival at Beaufort, the Laboratory may be reached by taxi.

The Beaufort area is well known for its moderate climate during the summer. Air temperatures range from an average minimum of 70° F. to an average maximum of 86° F. There is a prevailing southwest breeze from the ocean during most of the summer. Water temperatures range from 22-29° C. in June and from 24-30° C. during August.

Students should bring clothes suitable for field work including a sun hat, tennis shoes, bathing suit, shorts, work gloves, and sunglasses.

There are ample opportunities for recreation in and around Beaufort for swimming, fishing, boating, and water-skiing. On campus there are recreational facilities for swimming, diving, shuffleboard, horseshoe pitching, volleyball, croquet, and table tennis.



2

Resources for Study

Flora and Fauna

Beaufort is approximately midway between Woods Hole, Massachusetts, and Miami, Florida, in an area within the range of both the northern and southern species of biota. The edge of the Gulf Stream system is about 35 miles offshore, and between it and the shore occasional reefs are found.

The Beaufort area is strategically located for biological research because of the richness of its flora and fauna, and the ease with which one may reach many diverse habitats. From the Laboratory, by boat or automobile, the ocean, Cape Lookout and the Outer Banks, Bogue and Core Sounds, Harker's Island, rivers, creeks, canals, mud flats, sand beaches, dunes, marshes, peat bogs, cypress swamps, bird islands and rookeries, and coastal forests are readily accessible. Long leaf pine, yaupon, and at least seven species of insectivorous plants (protected by law), including the Venus flytrap, grow in the region. A great variety of algae, both freshwater and marine, is also available for study. Common animals include the king crab, squid, shrimps, snails, clams, ctenophores, jellyfish, hydroids, sponges, polychaetes, sea urchins, starfish, brittle stars, sand dollars, skimmers, terns, gulls, herons, sea turtles, porpoises, and many different types of fish.

Research Interests

Much of the Marine Laboratory's early research consisted of determining distribution of plants and animals within the varying environments of the Beaufort estuary. With the addition of the Cooperative Oceanographic Program and the expansion of year-round activities, the general theme of the relationship of animals and plants to their environment has been broadened to include all segments of the estuarine and oceanic environments. Year-round research by resident staff, associates, visiting staff, and graduate students generally falls into five broad disciplines: biochemistry, developmental biology, oceanography, physiology, and systematics-ecology.

Biochemistry. The primary emphasis in the biochemical studies involves research on the structure, function, and evolution of protein molecules. Proteins, especially those involved in the transport of molecular oxygen (hemoglobin, hemocyanin, chlorocruorin, and hemerythrin), are being isolated and their structural and functional properties elucidated. These studies are intended to illustrate how molecules have evolved and how they are involved in adaptive processes. From comparative studies one can illuminate structure-function relationships and derive data from phylogenetic significance. Studies of protein polymorphisms are also intended to illustrate gene flow among populations and offer insights into the adaptive strategies of marine organisms.

Developmental Biology. Much of the research in developmental biology deals with the culture of invertebrate larvae under controlled conditions in the laboratory, from hatching until the juvenile stages are reached. The availability of numerous larvae of known species, age, and stage of development has led to studies on the extent to which environmental factors within the marine environment affect rates of development, survival, and morphological abnormalities. In addition to studying the effects of natural environmental factors, research is under way to determine the effects of pollutants on larval development of marine Crustacea. The developmental biology program also includes studies on the physiology of crustacean larvae and the factors involved in regulation of molting, rate of development, and metamorphosis during larval development.

Oceanography. Within the Oceanography Program, research is being conducted to examine the physical and biological dynamics of marine ecosystems which are enriched by upwelling, including the Coastal Upwelling Ecosystems Analysis Program, a multi-university and multi-ship field experiment concentration on the northwest African coast upwelling. Other interests include the effect of metal and dissolved organic interactions on the biological productivity of the upwelling system and the measurement and modeling of carbon productivity of the ecosystems. Research is also under way on the rate of recycling of sewage sludge and the impact of sewage disposal on marine systems, the chemical form and biological reactivity of toxic and essential metals as determined by electron paramagnetic resonance, the ability of phytoplankton to synthesize coordination compounds that form complexes with metals and alter their biological reactivity, and the isolation and identification of hydroxamic acids suspected of being responsible for the biogenic conditioning of sea water.

Geological investigations are primarily concerned with processes of continental margin sedimentation, largely within the Carolina continental shelf slope and rise, and also in certain deep basins in the vicinity of the Bahama Banks. Studies are concerned with the origin of postdeath shell coloration and the sediment distribution and sedimentary processes on the Cape Hatteras sediment plume, characterization of the continental rise and the relative importance of bottom currents versus gravity flows in forming the rise, and delineation of individual sorting effects. Additional research involves sea floor topography, including contouring and diagramming continental and insular margins with emphasis on the distribution and patterns of submarine canyons. Geomorphic studies are also under way in support of investigations in the Caribbean.

Physiology. In the realm of physiological studies, one primary interest involves studies on the photobiology of organisms in the marine environment, with emphasis on behavioral orientation to light. This involves determining the

responses of a variety of marine organisms (unicellular dinoflagellates, larval crustaceans, and fish) to light, both in the natural environment as well as in the laboratory. Primary attention is on the identification of the light receptive pigments participating in the responses and the circadian rhythm of these responses. Accordingly phototaxis is used as a model system for studying the basic physiology of rhythms.

A second primary interest is in the mechanisms of ionic and osmotic regulation in marine plants and animals. This work involves a collaboration between the Department of Physiology and Pharmacology of Duke University and the Biochemistry Department of the University of Liege, Belgium. Euryhaline organisms can survive drastic fluctuations in salinity, and the internal adjustments made by these organisms may involve large changes in concentrations of amino acids and inorganic ions. One of our primary goals is to elucidate the metabolic processes which are responsible for these regulatory changes. Some marine organisms possess giant cells which offer unique opportunities for studying membrane transport processes. By internally perfusing these cells by means of micropipets we can control the internal ionic composition, hydrostatic pressure, and transmembrane voltage and current. At the same time we can measure the rates of solute and water movements across the cell surface, thus gaining insight into the mechanisms and functions of the transport processes.

Systematics-Ecology. Research in the systematics-ecology program involve studies on community structure, benthic algae, and distribution of certain marine species off the North Carolina coast.

The major objective of studies on community structure is to identify and understand the processes which result in the temporal and spatial patterns in species abundance in some subtidal, epibenthic communities. Changes in the adult populations are followed with mapping and photographic techniques. The approach is experimental to the extent that species can be removed or excluded from the community to assess their importance in community structure and function. An eventual goal is the development of a systems model incor-





porating the basic community processes to provide the basis for predicting the deliberate or accidental effects of man's perturbations of these communities.

In part because the middle Atlantic coast is a meeting ground for the cool water species typical of northern shores and the warm water species of the Caribbean, studies include the determination of the distribution, phenology, and systematics of benthic algae off the coast of North Carolina. This work includes efforts to determine community structure and productivity in the different portions of Onslow Bay and to extend the studies north and south along the entire coast. A second aspect of the work is a descriptive study of the epiphytic algae which grow in the sounds on the blades of eel grass and other marine angiosperms.

Additional studies are being conducted to investigate the growth rates and development of suspension feeders in relation to temperature, size of the animals, concentration of suspended material, and the relative concentration of phytoplankton in suspension. These experiments involve natural seawater in a continuous flow system in which the concentration of phytoplankton can be monitored. The data should determine the conditions under which maximum energy transfer occurs between primary producers and a primary consumer, facilitating the future exploitation of scallops, oysters, and other similar species.

Research Facilities

Laboratory Equipment and Supplies. Visiting investigators may obtain research space throughout the year. Each research laboratory building is air-conditioned and equipped with running sea water through a hard rubber system. There are tanks, water tables, aquaria, autoclave, ovens, and plant presses. In addition to commonly used laboratory equipment, the following are available: two refrigerated centrifuges with multi-speed attachments, Beckman DU spectrophotometer, balances, pH meters, hoods, and constant temperature equipment. Each person is expected to supply his own optical equipment or other special apparatus needed. A list of equipment, chemicals, and glassware may be obtained upon request. The Laboratory also maintains a darkroom and well-equipped workshop.

New Research Facility. A three-story modern research laboratory was completed in early summer 1972. Each room is well lighted artificially and all

exterior rooms also receive natural light. Most rooms have a view of the water surrounding some part of Pivers Island. All rooms are air-conditioned and heated electrically so that the temperature of each room can be controlled to suit the needs of the occupant. Hot and cold water, air, gas, and vacuum are available in most rooms. The non-metallic sea water system is especially designed to reduce silt and fouling. The general arrangement of rooms on each floor provides for a core of rooms in the center of the building which are for general use and research rooms of different sizes are at the periphery of the building. Although the rooms on all three floors were designed for special purposes, they may be used for research in a variety of disciplines.

Oceanographic Study. The 117.5-foot research vessel *Eastward* with a capacity for forty students on eight-hour cruises or fourteen students and staff on extended cruises may be used for oceanographic research. During the present year, the ship will operate in the Atlantic Ocean from the coast to the mid-Atlantic Ridge and south to Venezuela. It is outfitted with modern recording and collecting devices, and is available to investigators and teachers of graduate courses in marine sciences and their students. Application for ship time must be made in advance. Inquiries should be addressed to the Oceanographic Program Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Collecting. Spades, shovels, sieves, and nets are provided without charge to assist the investigator with his collecting. A wide assortment of boats is available for various collecting activities. A complete schedule of boats and charges may be found in the section on Financial Information.

New Library-Auditorium. The construction of the library-auditorium was completed and furnished in September 1973. The building is air-conditioned and electrically heated.

The library has stack space for 18,500 volumes on the first floor and a second deck for future expansion. The building also houses a librarian's office, room for duplicating machines, a receiving room, a small kitchen, two seminar rooms and two closed carrels.

Currently the Pearse Memorial Library contains over 4,200 catalogued reference books and journals, 150 current journals and 16,100 reprints. With the new fireproof stack areas valuable books, including expedition reports in oceanography, will be transferred from the Durham Campus to the Beaufort Campus. A microfilm library of graduate student theses based on research at the Laboratory, a microfilm reader, and a Xerox copier are also available. The librarian may obtain other materials by a special delivery system from the Perkins Library on the main Campus or through the interlibrary loan service with other libraries in the United States.

The auditorium will have a seating capacity of 300; therefore, it will be suitable for lectures, seminars, symposia, and small regional or national meetings.

Reference Collections. A reference collection of approximately 1,500 different species of animals from coastal North Carolina is available to students and research personnel. Small collections of marine algae and vascular flora are also maintained, as well as a checklist by habitat of the common marine animals.

Computing Facilities. A PDP 11/20 digital computer is available for general student and staff use. It has an 8-K core memory bank and uses BASIC, a conventional, on-line language similar to FORTRAN. The input-output device is an ASR-33 teletype.



3

Financial Information

Tuition

Summer Terms. The following are tuition charges for summer registration and medical care:

1. Undergraduate students: \$207.00 for each non-laboratory course; \$276.00 for each undergraduate laboratory course; and \$414.00 for each one and one-half course (six-unit) program offered at the Duke University Marine Laboratory.
2. Graduate students: \$69.00 per unit; and for an undergraduate course, the tuition rate indicated in section 1 above is applicable.
3. Full-time teachers in elementary and secondary schools: one-half of the tuition charge specified in sections 1 and 2 above is applicable.

The Director of the Summer Session will notify the applicant of course approval. Tuition should then be paid promptly to the Director of Summer Session, Duke University, Durham, North Carolina 27706, to assure reservation in a course.

Spring Term. Tuition, at the rates indicated in the Bulletin of Undergraduate Instruction, will be paid at Duke University not later than the day of registration for the term.

Tuition must be received at least one week before the beginning of the term. Students who have not completed registration by 4:00 p.m. of the final day of registration of each term will be subject to a late registration fee.

Research Space

Individual research cubicles varying from 80 to 400 square feet are available at the Duke University Marine Laboratory. The rental fee for research space is \$1.00 per sq. ft. per month from May 1, 1974, to April 30, 1975.

No additional charges are made for research assistants occupying the same research space as the investigators. Graduate students from institutions



other than Duke University will be charged one-half the regular rate per person. Laboratory space rental does not apply to students participating in the Spring Undergraduate Program.

Inquiries and requests for space should be addressed to Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. Applications for the academic year are encouraged and will be acted upon shortly after they are received. All research applications for the summer of 1974 must be received by March 10, 1974.

Living Accommodations

Dormitories. Air-conditioned and a few non-air-conditioned dormitory rooms are available. Although every effort is made to limit two people per dormitory room, a few triple rooms may be needed to accommodate all individuals requiring dormitory space. Prospective students should indicate their preference for housing on the application for enrollment. It is impossible to guarantee that these preferences will be available in all cases.

Occupants must supply their own linens, blankets, and towels, but pillows will be furnished. All dormitory occupants will be on the board system during the summer terms. A key deposit of \$1.00 will be charged each person occupying a dormitory room, with the deposit to be refunded at time of departure.

Dormitory charges which are payable at the Business Office of the Laboratory upon arrival are as follows:

Summer 1974

Non-air-conditioned double	\$59.00 per term for each occupant
Air-conditioned double	\$75.00 per term for each occupant
Air-conditioned triple	\$54.00 per term for each occupant

Spring, 1975

Non-air-conditioned double	\$195.00 per semester for each occupant
Air-conditioned double	\$228.00 per semester for each occupant
Air-conditioned triple	\$187.00 per semester for each occupant

Double rooms for married students are normally supplied only if both husband and wife are registered students at the Laboratory.

Beaufort Housing. Because Beaufort is located in a resort area, off-campus housing is very difficult to obtain and costs may range from \$20.00 to \$50.00 per week per person. Housing for married couples who are not both registered students at the Laboratory and couples with children in the Morehead City-Beaufort area is limited. A list of area realtors will be mailed to students upon request.

Dining Facilities*

The Duke University Marine Laboratory Dining Hall will be open during the second and third summer sessions. All dormitory residents are required to pay the full board fee of \$140.00 per term. Students residing off-campus may purchase a full board meal ticket, weekly meal ticket, or individual meals. In-

*Dining hall meals will be served for first summer session; however, rates have not yet been determined. All dining hall rates are subject to change without notice.



dividual meals are the most expensive and full board is the least expensive on a meal-by-meal basis. Individual meal rates are as follows:

Breakfast	\$.95
Lunch	\$1.60
Dinner	\$2.10
Sunday Dinner	\$2.40

Children under twelve will be charged one-half the adult rate.

The full board fee (at approximately a 12 percent savings from individual meals) provides for three meals per day, Monday through Saturday, and breakfast and noon dinner on Sunday. No credit will be allowed for meals that are missed, including those meals which may be missed as a result of research cruises in conjunction with course work. Meals will normally be provided on these cruises.

Research personnel and their families residing off-campus are urged to eat in the dining hall. Arrangements may be made for occasional meals if sufficient notice is given at the Business Office of the Laboratory.

The board fee is payable in full on or before the day of registration at the Business Office of the Laboratory.

Boat Rentals

The following boats are available at the Laboratory for collecting and instructional activities:

Boat Type	Name	(Charges Effective Sept. 1, 1973)
55 ft. trawler	Beveridge*	\$ 26.00 per hour \$208.00 per day
39 ft. cabin Diesel powered	Venus*	\$ 18.00 per hour \$144.00 per day
17.5 ft. speedboat	Thunderbird	\$ 14.00 per hour \$112.00 per day
22.10 ft. open boat	Ocyopode	\$ 14.00 per hour \$112.00 per day
Boston Whaler		\$ 6.00 per hour \$ 48.00 per day
Skiffs with outboard motors		\$ 3.50 per hour \$ 25.00 per day

*Crew required for safety of user and vessel.

These rates are intended to partially defray the cost of operating and maintaining these boats.

These boats may be scheduled by visiting researchers through the Maintenance Office; however, first priority must be given to classes when they are in session during the spring and summer terms.

If crew overtime is involved before or after their normal work day and any time Saturday or Sunday, the following charges will be made from January 1,

1974, to April 30, 1975: Master, \$5.55 per hour; Winch Operator, \$5.00 per hour; additional charge for overtime on Duke University holidays, \$3.00 per hour.

Other Financial Information

Check Cashing. The banks in the Morehead City-Beaufort area have indicated that they will not cash personal checks for students unless they are guaranteed. Therefore, it is recommended that students at the Laboratory bring with them sufficient travellers checks, money orders, certified checks, or cash to cover expenses.

Other fees. Late registration fees will be charged in accordance with Duke University policy unless registration is completed and all fees paid by the last day of registration for the term.

Awards

Undergraduate. Undergraduate students who wish to be considered for appropriate financial awards should write to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.





4

Admission

Requirements and Procedures

All students applying to the Duke Marine Laboratory should complete the appropriate application form at the back of this *Bulletin* and submit a transcript of their grades. Applicants will be considered without regard to race, color, religion, sex, or national origin. Students desiring a transfer of credit to their home institutions should request a course approval form for transfer of credit from the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Summer Terms. All courses offered at the Laboratory during the summer are intended for graduate students and senior undergraduate students. Applications should be submitted to the Director of the Laboratory as early as possible and not later than March 10. Late applicants will be admitted if space permits. After acceptance, payment of tuition is essential to assure reservation in a course.

Students wishing to apply summer credits toward an advanced degree at Duke University must, in addition to filling in the application blank, register with the Duke University Graduate School. Students who have had adequate preparation and approval of their major professor may request space for independent or thesis research.

Students should plan on arriving between noon and 6:00 p.m., Sunday, May 12 (Term I), Sunday, June 16 (Term II), or Sunday, July 21 (Term III), at which times dormitory rooms will be ready for occupancy. Final registration will begin for all students at 8:00 a.m., May 13, 8:00 a.m., June 17, and 8:00 a.m., July 22.

Spring Semester. An interdisciplinary program in the marine sciences is offered at the Duke Marine Laboratory for the spring semester. The program is open to qualified juniors and seniors from Duke and other colleges and universities. Applications are to be submitted by October 7 to the Director of the Laboratory. Each applicant should request two letters of recommendation, one of which must be from the director of undergraduate studies, or the equivalent, from the student's major department. Students will be notified of the action of the admission committee prior to registration for the spring semester.



5

Courses of Instruction

FIRST SUMMER TERM

May 14-June 15, 1974

Introduction to Biological Oceanography. (Zoology 114L.) Physical, chemical and biological processes that characterize the oceans, emphasizing special adaptations of organisms for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: college biology. One and one-half course (6 graduate units). Staff

SECOND SUMMER TERM

June 17-July 17, 1974

Independent Study. (Botany, Geology, or Zoology 192T.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. Staff

Marine Ecology. (Zoology 203). Ecological processes as exemplified by marine organisms. Lectures will cover environmental factors, intra- and inter-specific relationships, and community ecology. Class discussions on selected papers. Field projects utilizing current ecological methods. Practice in scientific writing. Use of computers in ecology. Prerequisites: a course in general zoology, invertebrate zoology, or an appropriate equivalent, and a year of mathematics; some knowledge of statistics will be helpful. One and one-half course (6 graduate units). Sutherland

Comparative and Evolutionary Biochemistry. (Biochemistry or Zoology 276.) Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, elec-



trophoresis, ion-exchange and molecular exclusion chromatography, finger-printing, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. One and one-half course (6 graduate units). Sullivan

Invertebrate Embryology. (Zoology 278.) Lectures, readings, and laboratory work dealing with rearing, development, and life history of invertebrates. Prerequisite: consent of the instructor. One and one-half course (6 graduate units). Bookhout

Introductory Marine Microbiology. (Botany 205.) The biology of micro-organisms in oceans and estuaries. Prerequisite: one year of college biological science. One and one-half course (6 graduate units). Blankley

Physiological Ecology of Marine Animals. (Zoology 250.) A study of the physiology of marine and estuarine animals in relation to certain environmental factors (temperature, salinity, oxygen, and light). Animals representing numerous phyla from various habitats are studied. Prerequisite: a course in physiology and general zoology. One and one-half course (6 graduate units). Forward

Introduction to Comparative Behavior. (Zoology 202.) Analysis of behavior, as revealed by physiological, evolutionary, and ecological study. Primary (but not exclusive) emphasis is placed upon marine groups. Lectures and laboratories. Prerequisite: one course in physiology. Two courses (6 graduate units). Salmon

Chemical Oceanography. (Chemistry 240.) Chemistry and thermodynamics of multi-component systems and application in the marine environment. Distribution and transport of chemical species will be described in terms of the processes that determine the chemical make-up of the oceans. Emphasis will be placed upon the quantitative evaluation of natural buffers in seawater, rates of reactions in seawater and at solid-liquid boundaries, gas exchange at the sea-air interface, and the alteration of chemical equilibria by temperature, pressure, and ionic strength. The distribution of dissolved nutrients in the ocean will be discussed in terms of life cycles and the role nutrients play in photosynthesis. Problem solving will be used to a large extent for illustrating the principles of chemical oceanography. Prerequisites: chemistry and calculus. One and one-half course (6 graduate units). Baier

Research. (Zoology 354.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory required. (For graduate students only.) Staff

THIRD SUMMER TERM

July 18-August 17, 1974

Independent Study. (Botany, Geology, or Zoology 191T.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. Staff

Membrane Physiology and Osmoregulation. (Physiology 212.) Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. The course includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation



in marine plants and animals. Laboratory work deals with ionic transport processes in gills and other epithelia, basic electrophysiology and synaptic transmission in mollusks, kidney function in fish, amino acid transport and metabolism in crustaceans, and the application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: permission of instructor. One and one-half course (6 graduate units). Gutknecht, Wachtel, and Staff

Marine Invertebrate Zoology. (Zoology 274.) A study of invertebrate animals that occur in the Beaufort region. A number of field trips will be made to a variety of habitats to study and to collect animals in their natural environment. The structure and habits of living invertebrates, as well as their behavior under experimental conditions, will be studied in the laboratory. (Zoology 274 is not intended for students who have had a graduate course in invertebrate zoology.) Prerequisite: a course in general zoology or general biology. One and one-half course (6 graduate units). Staff

Biological Oceanography. (Zoology 214.) The special adaptations of organisms for life in the sea and the impact of biological processes on the non-living components of the marine environment provide the core of the biological oceanography course. Among the ideas emphasized are the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in regulating the abundance, distribution, and community organization of marine organisms. A cruise on the *R/V Eastward* will investigate the physical and chemical processes which support the biological productivity of the continental shelf ecosystem. Prerequisites: chemical oceanography (offered second summer term) or permission of instructor. One and one-half course (6 graduate units). Barber

Marine Phycology. (Botany 211.) An introduction to marine algae—their identification, taxonomy, morphology, physiology, and ecology. Field trips are complemented by laboratory study, culturing, and preparation of herbarium material. One and one-half course (6 graduate units). Searles

Geological Oceanography. (Geology 205.) The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. (The course is not open to students who have completed Geology 206.) One and one-half course (6 graduate units). Pilkey

Research. (Zoology 353.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory is required. (For graduate students only.) Staff

Spring Semester—Undergraduate Program

The semester program consists of the courses listed below. A student may apply during the spring to continue study at the Marine Laboratory during the summer either by participating in senior-graduate courses or by continuing the independent studies initiated during the spring term.

Man and the Marine Environment. (Interdisciplinary Course 104.) Economic, legal, medical, political, social, and scientific viewpoints on the extent to which modern society has affected the marine environment, with special emphasis on problems of coastal North Carolina. Lectures and laboratories. Pre-



requisite: consent of instructor and director of undergraduate studies of student's major department. One course. Costlow and Staff

The Marine Environment. (Botany, Geology, or Zoology 169.) The interrelationships of the geological, chemical, and biological aspects of the estuarine and oceanic environments. Lectures and laboratories. Prerequisite: introductory chemistry and consent of instructor and the appropriate director of undergraduate studies. One course. Sutherland

Physiology of Marine Organisms. (Zoology 150L.) Comparative physiology of marine animals including special ecological behavioral adaptations. Lectures and laboratories. A student may not receive credit for both Zoology 150L and 250L. Prerequisite: introductory biology and chemistry; consent of instructor and director of undergraduate studies of student's major department. One course. Forward

Seminar. (Biochemistry 296S.) Recent research in the biochemistry and genetics of marine organisms. Half-course. Sullivan. (Botany 296S.) Current topics in coastal and marine botany. Half-course Blankley. (Zoology 296S.) Man's impact on biogeochemical cycles. Half-course. Barber and Baier.

Independent Study. (Botany, Geology, or Zoology 192T.) For senior and junior majors with permission of the director of undergraduate studies and the supervising instructor. One and one-half course. Staff



6

Seminars

Academic Year 1972-1973

Date	Speaker	Topic
Sept. 28	Dr. Alan R. Bandy Old Dominion University Norfolk, Virginia	Raman spectroscopy and its application to problems of oceanography
Dec. 11	Mr. L. N. Klissurov Construction Engineer Laboratory for Underwater Investigation Institute of Oceanography Bulgaria	Marine engineering in Bulgaria
Dec. 18	Dr. R. Natarajan, Director Center of Advanced Study in Marine Biology Annamalai University Porto Nova, India	Speciation in Neritidae (Gastropoda-Mollusca) in Veller Estuary, Porto Nova, India
Jan. 1	Mr. Walker Smith, Jr. Duke University Durham, North Carolina	A critical review of mathematical models of primary productivity
Jan. 23	Dr. Clarence M. Tarzwell Senior Research Advisor Beace Dale, Rhode Island	Waste management in the aquatic environment
Jan. 24	Dr. Thomas Linton, Commissioner of Fisheries Department of Natural and Economic Resources State of North Carolina	The Coastal Zone Management Program of North Carolina
Jan. 25	Dr. Joseph Bonaventura Duke University Marine Laboratory	Historical introduction to the Root effect in fish blood
Jan. 29	Dr. Donald Hoss, Commissioner Lower Neuse Soil Conservation District	Effects of stream channelization and mosquito control drainage on marshes

Feb. 2	Mr. N. W. Taylor Attorney-at-Law Beaufort, North Carolina	Improvements in the rough road to court ordered pollution abatement
Feb. 7	Mr. Thomas Kane Office of the Attorney General State of North Carolina	Federal legislation and the environment
Feb. 15	Dr. Hans Fyhn University of Oslo Oslo, Norway	Physical considerations of gases as related to aquatic life
Feb. 19	Dr. Paul Godfrey Department of Botany University of Massachusetts Amherst, Massachusetts	Maintenance of the outer banks
Feb. 26	Mr. Robert Chapoton National Marine Fisheries Service NOAA Beaufort, North Carolina	The problems of one natural resource
March 15	Dr. Charlotte Mangum Department of Biology College of William and Mary	The function of hemoglobin in the blood worm <i>Glycera dibranchiata</i>
March 29	Dr. W. E. Krumbien Biologische Anstalt Helgoland Helgoland, Germany	The Solar Lake, a meromictic lake on the shores of the Gulf of Aquaba, Israel: Its genesis, exchange with the sea, and biology of its algae mats
March 30	Dr. Thomas Duke Pesticide Laboratory Environmental Protection Agency Gulf Breeze, Florida	Pesticides in the marine environment
March 30	Dr. Joseph Mihursky Natural Resources Institute Chesapeake Biological Laboratory Solomons, Maryland	Heated effluents in the estuaries
April 5	Dr. Jeremy Jackson The Johns Hopkins University	Biogeographic consequences of eurytopsy and stenotopy among marine bivalves and their evolutionary significance
April 11	Dr. Ruth Turner Museum of Comparative Zoology Harvard University	The biology of deep water ship worms

April 18	Dr. Ralph Fadum Dean of Engineering North Carolina State University Raleigh, North Carolina	Ground water and the coastal environment
April 20	Dr. Robert Barbee, Director Cape Hatteras National Seashore U.S. Park Service Manteo, North Carolina	National seashores, sand and politics
April 26	Dr. Sally Woodin Department of Zoology University of Maryland College Park, Maryland	The importance of biological interactions in soft bottom benthic communities: An experimental approach
May 2	Dr. Celia Bonaventura Duke University Marine Laboratory	Molecular control of hemoglobin function
May 3	Professor Jose Stirn, Director Marine Laboratory, Portoroz University of Ljubljana Ljubljana, Yugoslavia	An introduction to hard-bottom benthic communities in the Mediterranean
May 4	Professor Rudolph Atcon Senior Specialist, Higher Education Department of Educational Affairs Organization of American States	Cooperative marine biology programs in Latin America: Present and future
May 9	Dr. John Sutherland Duke University Marine Laboratory	Experimental studies on fouling communities
May 11	Dr. Martin Newman NOAA National Marine Fisheries Service Oxford, Maryland	Histopathology of Cunner (<i>Tautogolabrus adspersus</i>) associated with 96 hr. exposures to cadmium chloride in seawater
May 17	Dr. Richard Forward Duke University Marine Laboratory	Dinoflagellate phototaxis, pigment system, and circadian rhythm as related to diurnal migration
May 18	Professor Jack Dainty Botany Department University of Toronto	Fundamental problems in the water relations of plants, from an ecological point of view
May 23	Professor Unnsteinn Stefansson Marine Research Institute Reykjavik, Iceland	UNESCO's oceanography program

May 24	Professor Unnstein Stefansson Marine Research Institute Reykjavik, Iceland	Training and education in marine science under the auspices of the U.N. agencies
May 25	Professor D. J. Crisp, FRS University College of North Wales Marine Science Laboratories Menai Bridge, Anglesey Wales, U.K.	Fish culture in Japan
May 29	Dr. Mary Crisp Gatty Marine Laboratory St. Andrews, Scotland	Receptors in mollusks
June 19	Dr. Orrin Pilkey Department of Geology Duke University Durham, North Carolina	The coastal crisis
June 20	Dr. Kenneth W. Horch Department of Physiology The University of Utah Medical Center Salt Lake City, Utah	Sound and squirrelfish
June 21	Dr. Graham Walker NERC Unit Marine Sciences Laboratory Menai Bridge, Anglesey Wales, U.K.	Barnacle studies; with particular reference to the cement apparatus
June 28	Dr. Rodger Baier Duke University Marine Laboratory	Lead distribution in coastal waters
July 5	Dr. Susan Huntsman Duke University Marine Laboratory	Conditioning of seawater
July 12	Dr. Margit Jensen Universitetets Zoologiske Museum Universitetsparken 15, DK-2100 Copenhagen, Denmark	The variation in the skeletal structures of the pedicellariae and teeth of the Strongylocentrotids
July 17	Dr. Gordon Leversee Department of Biology Nasson College Springvale, Maine	Power plant entrainment as a source of zooplankton mortality: Thermal effects vs physical effects
July 19	Dr. John Miller Biology Department Baldwin-Wallace College Berea, Ohio	The closed marine culture system—An educational tool
July 24	Dr. Joseph Bonaventura Duke University Marine Laboratory	Molecular adaptations in fish hemoglobins

July 26	Dr. John Gray Wellcome Marine Laboratory Robin Hood's Bay England	Predicting and monitoring effects of pollution in the sea
July 31	Dr. Roy Weber Institute of Zoophysiology University of Aarhus Aarhus, Denmark	Effects of anionic and cationic salt components on oxygen binding of <i>Arenicola haemoglobin</i>
August 2	Dr. Frank C. Schatzlein California State University Long Beach, California	Regulation of glycolyses in a shore crab
August 7	Dr. Richard Searles Department of Botany Duke University Durham, North Carolina	Seaweeds of the sub- Antarctic coast of South America
August 9	Dr. Gordon Thayer NOAA Pivers Island Beaufort, North Carolina	Structural and functional aspects of an eelgrass community
August 14	Dr. Dave Evans Biology Department University of Miami Coral Gables, Florida	Sodium balance in bony fish
August 16	Dr. Harold E. Edgerton Department of Electrical Engineering MIT Cambridge, Massachusetts	Uses of sonar and elapsed time movies of star fish, urchins, and sand dollars
August 21	Dr. Irvine Hagadorn Department of Zoology University of North Carolina Chapel Hill, North Carolina	Studies on spermatogenesis in <i>Hirudo</i>





7

Publications

1972-73

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Appendix

CALENDAR FOR SUMMER SESSION, 1974

Term I, Instruction begins—May 14
Term I ends—June 15

Term II, Instruction begins—June 17
Term II ends—July 17

Term III, Instruction begins—July 18
Term III ends—Aug. 17

ADMINISTRATION AND LABORATORY PERSONNEL

Advisory Committee

John D. Costlow, Ph.D., Director
Duke University Marine Laboratory

Sigfred A. Linderoth, Jr.
Department of Mechanical Engineering

Joseph Bailey, Ph.D., Acting

Orrin H. Pilkey, Ph.D
Department of Geology

Chairman

Department of Zoology

Louis Quin, Ph.D., Chairman
Department of Chemistry

John W. Gutknecht, Ph.D.

Department of Physiology and
Pharmacology

Richard B. Searles, Ph.D.
Department of Botany

R. L. Hill, Ph.D.

Department of Biochemistry

Administrative Staff

Director

John D. Costlow
Professor of Zoology

Marine Superintendent of Oceanographic Operations

John G. Newton

Director of Cooperative Program in Biological Oceanography

Coordinator, Coastal Upwelling
Ecosystems Analysis

Assistant Marine Superintendent of Oceanographic Operations

Eric B. Nelson

Richard T. Barber

Associate Professor of Zoology and
Botany

Master of R/V EASTWARD

Ragnvald Sandoy

Business Manager

Craig Horne

Information Specialist Coastal Upwelling Ecosystems Analysis

Robert H. Warsing

Maintenance Supervisor

Norris Hill

Academic Staff

Rodger Baier, Ph.D.

Chemical oceanography

I. E. Gray, Ph.D., Professor

Emeritus

Marine ecology and entomology

Richard T. Barber, Ph.D.

Biological oceanography

John Gutknecht, Ph.D.

William Blankley, Ph.D.

Phytoplankton systematist

Membrane physiology

Joseph Bonaventura, Ph.D.

Protein structure and function

*Orrin Pilkey, Ph.D.

Geological oceanography

C. G. Bookhout, Ph.D.

Marine invertebrate embryology
and invertebrate zoology

*Michael Salmon, Ph.D.

Behavior of marine animals

John D. Costlow, Ph.D.

Marine invertebrate embryology
and experimental zoology

*Richard B. Searles, Ph.D.

Marine phycology

Richard B. Forward, Ph.D.

Physiological ecology of marine
animals

J. Bolling Sullivan, Ph.D.

Comparative and evolutionary
biochemistry

John Sutherland, Ph.D.

Marine ecology

*Summer only

Research

Rodger Baier, Ph.D.
Duke University Marine Laboratory
Staff
Trace metal studies in coastal waters.

Richard T. Barber, Ph.D.
Duke University Marine Laboratory
Staff
Coastal upwelling ecosystems analysis; biogeochemical cycling of organic matter and metals; and phytoplankton nutrition and organometallic complexes in the sea.

William Blankley, Ph.D.
Duke University Marine Laboratory
Staff
Phytoplankton systematics.

Celia Bonaventura, Ph.D.
Duke University Marine Laboratory
Research Associate
Photochemical reactions of protein molecules.

Joseph Bonaventura, Ph.D.
Duke University Marine Laboratory
Associate, Department of Biochemistry
Duke University
Protein structure and function.

C. G. Bookhout, Ph.D.
Duke University Marine Laboratory
Staff
Effects of controlled environmental factors on the development of estuarine and oceanic Crustacea.

Marit Christiansen, Ph.D.
University of Oslo
Oslo, Norway
Nordic Fellow
Salinity and temperature effects on crab larvae, and effects of the larvicide ZR 515 on the development of crab larvae in various salinities and temperatures.

John D. Costlow, Ph.D.
Duke University Marine Laboratory
Staff
Effects of controlled environmental factors on the development and distribution of estuarine and oceanic Crustacea; the effect of cyclic temperature on larvae of marine invertebrates; and studies on molting and growth in larval and adult barnacles and larval decapods.

Richard Forward, Ph.D.
Duke University Marine Laboratory
Staff
Investigations of the photobiology of dinoflagellates and larval crustaceans.

Hans Fyhn, cand. real.
University of Oslo
Oslo, Norway
Research Associate
Osmoregulation in marine invertebrates.

Unni Fyhn, cand. real.
University of Oslo
Oslo, Norway
Research Associate
Cement glands in barnacles; protein polymorphisms in fish.

I. E. Gray, Ph.D., Professor Emeritus
Duke University Marine Laboratory
Director, Reference Museum
Preparation of Atlas of marine benthic organisms.

John Gutknecht, Ph.D.
Duke University Marine Laboratory
Staff
Membrane physiology: Permeability and transport properties of marine algae and phospholipid bilayer membranes.

Susan Huntsman, Ph.D.
Duke University Marine Laboratory
Research Associate
Phytoplankton nutrition and organometallic complexes in the sea.

Charles Johnson, Ph.D.
Duke University Marine Laboratory
Research Associate
Life history studies of protozoan parasites in the blue crab, *Callinectes sapidus*.

William Kirby-Smith, Ph.D.
Duke University Marine Laboratory
Curator, Reference Museum
Influence of food concentration on the growth of scallops.

John G. Newton, B. A.
Duke University Marine Laboratory
Staff
Topography of the sea floor; Marine Biological Atlas of North Carolina.

Genevieve Payen, A. R., CNRS
Laboratoire d'Evolution de la Faculte des Sciences de Paris
Paris, France
Research Associate
Control of sexual differentiation in Crustacea.

Orrin Pilkey, Ph.D.
Department of Geology
Duke University
Staff
Eastern terminus of Hudson Canyon in the divide Sohm and Hatteras abyssal plains; seaward extensions of Washington and Wilmington submarine canyons on the lower continental rise; turbidity flow mapping, Hispaniola abyssal plain; contour current and North Carolina rise formation.

Richard B. Searles, Ph.D.
Department of Botany
Duke University
Staff
Study of the benthic communities on the continental shelf using facilities of R/V EASTWARD; and a descriptive study of the epiphytic algae which grow in the sounds of the blades of eel grass and other marine angiosperms.

J. Bolling Sullivan, Ph.D.
Duke University Marine Laboratory
Staff
Comparative aspects of protein chemistry.

John P. Sutherland, Ph.D.
Duke University Marine Laboratory
Staff
Experimental studies on the dynamics of fouling communities.

Roy Weber, Ph.D.
Department of Zoophysiology
University of Aarhus
Aarhus, Denmark
Research Associate
Respiratory physiology.

GRADUATE STUDENTS ENGAGED IN THESIS RESEARCH

Lesley Ann Barling, B.S.
Department of Zoology
Duke University
Relationship between Neosimnia and Leptogorgia.

Dale Benos, B.A.
Department of Physiology and Pharmacology
Duke University Medical Center
Membrane physiology.

Mary Berry, B.S.
Department of Zoology
Duke University
Biochemical changes during shrimp development.

John Commito, A.B.
Department of Zoology
Duke University
The regulation of estuarine soft bottom community structure.

Robert Dean, B.A.
Department of Zoology
Duke University
Microbiological investigation of marine wood-boring molluscs.

Humberto Diaz, Lic. Biol.
Department of Zoology
Duke University
Studies on settlement and recruitment process in the mole crab, *Emerita talpoida*.

Thomas Fisher, B.A.
Department of Zoology
Duke University
Physiology of fouling organisms.

James Graves, B.S.
Department of Physiology and Pharmacology
Duke University Medical Center
Membrane transport processes in marine algae.

David Hastings, B.A.
Department of Physiology and Pharmacology
Duke University Medical Center
Membrane transport processes in marine algae.

Duncan Howe, B.A.
Department of Zoology
Duke University
Gill membrane transport in toadfish *Opistognathus tau*.

Burton Jones, B.S.
Department of Zoology
Duke University
Modeling of phytoplankton growth in nutrient-rich, unconditioned seawater.

Ronald Karlson, B.A.
Department of Zoology
Duke University
Sea urchin disturbance and its effect on spatial distribution of marine fouling community organisms.

George Lapenas, B.A.
Department of Zoology
Duke University
Oxygen permeability of the teleost swim bladder.

Freddy Losada, Lic. Biol.
Department of Zoology
Duke University
Aspects of growth and shell deposition in barnacles.

Sharon Smith, M.Sc.
Department of Zoology
Duke University
Copepod nitrogen excretion as a process in estuarine nutrient cycles.

Research Technicians

Shirley Bourne, M.A.	John Freeman, M.S.	Karen Johnson, B.A.
Michael Bradley, M.S.	Lu Garrigan, B.A.	Doris King, B.A.
John Dean, B.S.	Gerald Godette, B.S.	Rebecca C. Piver
Clarke Edwards, M.S.	Teri L. Herbert, B.S.	Patrick Whaling
Janet Elliott, B.S.	Sally Herring	Sandra E. Woods, Ph.D.

SUPPORT STAFF

David L. Bunting Senior Draftsman	Horace Holland Mechanic	Herman Myers Senior Refrigeration and Air Conditioning Mechanic
James Chadwick Housekeeper	James B. Hunnings Custodian of Records and Relief Master/Mate	George A. Newton Oceanographic Party Chief
Claudia O. Davis Housekeeper	William Hunnings Electronic Technician	Jo Ann Rivera Secretary
Clifton Davis Carpenter	Dorothy T. Johnson Secretary	George S. Robinson Painter
Helen Davis Housekeeper	Ellen Jones Clerk Typist	Ruthella Rozier Senior Clerk typist
James M. Davis Oceanographic Party Chief	Mary Fond Jones Secretary	Sylvia Springle Secretary
Janet A. Ely Administrative Secretary	Fred L. Kelly Oceanographic Party Chief	Florence M. Taylor Senior Sponsored Programs Clerk
Annie C. Fulford Housekeeper	George Lockhart Light Equipment Operator	Sophia D. Turnage Junior Buyer
Dianne Gagnon Senior Accounting Clerk	Estelle G. Merrell Administrative Secretary	Jean S. Williams Library Assistant
Pam Garner Clerk Typist	I. Grayden Moore Carpenter	James L. Willis Boat Serviceman/Operator

R/V EASTWARD Personnel

Ragnvald P. Sandoy, Master	Delmas L. Guthrie, Seaman
Harold W. Yeomans, Chief Mate	Graham Guthrie, Wiper
Curtis Nelson, Chief Engineer	William M. Guthrie, Seaman
William A. Davis, First Assistant Engineer	Curtis A. Oden, Bosun/Deck Engineer
Harold G. Willis, Second Assistant Engineer	Benjamin H. Smith, Cook/Messman
James H. Miller, Jr., Second Mate	Howard L. Wilson, Steward/Cook
Tennie Davis, Oiler	Charles Jones, Seaman
Clyde R. Everett, Seaman/Messman	

**APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY
SUMMER SESSION**

Name
Please Print

Date

Reserve a place for me in the following course(s): (Only one 6-unit per term will be permitted; first and second choices may be indicated.) Each applicant should submit a transcript of grades to the Director.

FIRST TERM:

Course Number Title of Course

SECOND TERM:

Course Number Title of Course

THIRD TERM:

Course Number Title of Course

Fees will be paid by: Self Other

Reserve a room: TERM II TERM III

Attended Summer Sessions at Duke University Marine Laboratory: Yes No

Years

Request grade(s) be applied toward: If college student, list:

Undergraduate credits Undergraduate Year

Graduate credits Graduate Year

General (unclassified) Name and address of School:

If teacher: List name and address

of school

Married Single

Colleges and/or universities attended and degrees: Degree

Street Address Rural Route or P.O. Box

Post Office State Zip

Signature

Mail to: Director

Duke University Marine Laboratory
Beaufort, North Carolina 28516

**APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY
SPRING SEMESTER MARINE SCIENCES PROGRAM FOR UNDERGRADUATES**

Please type or print.

Date

1. Name
 last first middle

2. Social Security Number Sex: Male Female

3. Date of Birth: Month Day Year

4. A. Current mailing address:

City State Zip.....

Area Code Telephone Number

B. Permanent or home address:

City State Zip.....

Area Code Telephone Number

5. A. Present marital status: Single Married

If applicable, give number of dependent children

B. Name and address of next of kin:

Name Relationship

Address City State Zip.....

Area Code Telephone Number

6. A. Duke University undergraduate student;

Trinity College of Arts and Sciences

Engineering

B. Special student desiring transfer credit:

Name and address of home institution

.....

City State Zip

C. Major department Class

continued on reverse side

7. The following persons have been requested to mail letters of recommendation to the Director of the Laboratory:

A. Name Position

.....

City State Zip

Area Code Telephone Number

B. Name Position

.....

City State Zip

Area Code Telephone Number

8. Transcript(s) will be sent by the following institution(s):

.....

.....

.....

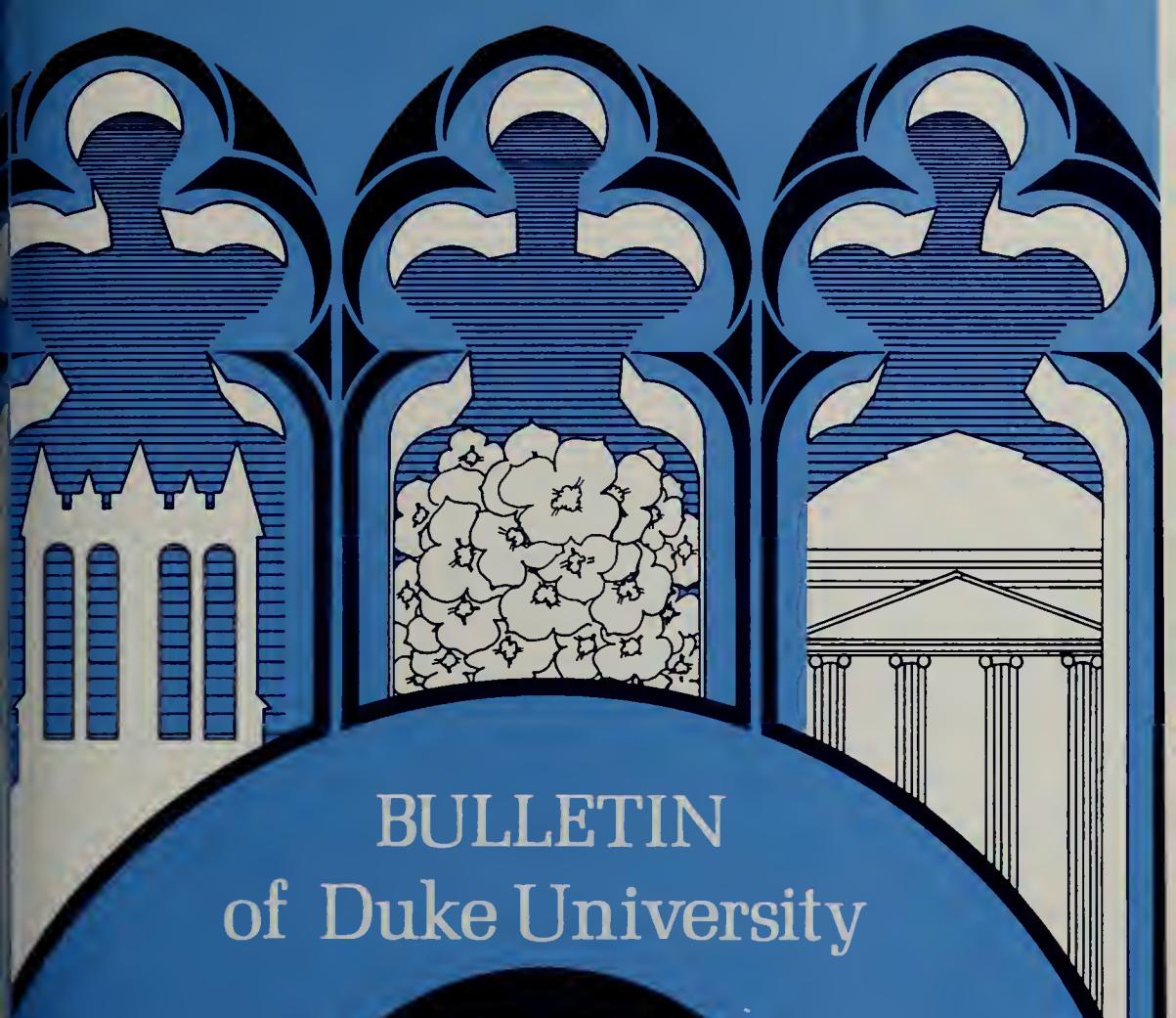
9. Have you ever been placed on probation or suspended or dismissed from any school?

Yes No (If yes, please explain below.)

Mail application to: Director
Duke University Marine Laboratory
Beaufort, North Carolina 28516







BULLETIN of Duke University

1974

1975



GRADUATE SCHOOL OF
BUSINESS ADMINISTRATION

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Contents

1 Degree Programs	1
The Master of Business Administration	1
The M.B.A. - J.D. Program	10
The Master of Science in Management	10
The Doctor of Philosophy	10
2 Admission and Financial Information	13
Admission	13
Financial Information	14
3 General Information	17
The Campus	17
The Library	18
Computing Facilities	18
Office of Placement Services	18
Living Accommodations	18
Motor Vehicles	19
Health Services	20

$f_j \sim \text{density of } g$

$$f_j(x) = (h-1) \int_{-\infty}^x g(x') dx'$$

$$[Cost] = \begin{cases} L(a) \\ T \end{cases}$$

1

Degree Programs

The Master of Business Administration

Most students who complete the M.B.A. program will begin a professional career that will span several decades. During that period they will hold positions of different types and of increasing responsibility. A deliberate decision to invest two years in the M.B.A. should be based on a careful estimate of how well the program prepares the student to perform during his early career and how well it prepares him to learn from his experiences and from other people in order to succeed in his later career.

During the coming several decades two major types of changes will occur. First, the structure of business and industry will change, creating new classes of problems unlike those of the past. For this reason, preparation to solve problems only within the structure of today's world would fail as preparation for solving problems arising from a new structure, and would fail as preparation to make significant departures from old structures. Second, the science of management and administration will change, making available new technology for use in solving the most pressing problems. The science of management is young and the rate of change will be very high. Therefore, a large proportion of the useful managerial technology available in a decade or more is yet to be developed.

To prepare for those changes, an M.B.A. program needs to graduate managers who are able to understand and to anticipate changes in problems that arise from shifts to new structures of organization in business and industry. Those graduates ought to be prepared to foster changes that improve the structure and operations of economic organizations in our society. Associated with these requirements is the need for an M.B.A. program to provide the intellectual foundations necessary to remain abreast of the rapidly changing sciences that underlie the most creative and useful management development.



The Duke M.B.A. curriculum is designed to meet these challenges through an emphasis on concepts and theory, and on their application. This involves evaluating and improving theory for use in the analysis of complex problems and the creation of effective plans. The curriculum is intended as managerial preparation in which an essential ingredient is the integration of the plans and activities of the various parts of a large organization, or of the various organizations that ought to build cooperative relationships. The program prepares the M.B.A. for imaginative, effective coordination of unlike organizations and for responsibilities in a wide variety of assignments within complex structures. A dominant theme is that good theory is useful theory, and direct application is one of the major uses of the concepts and theory in the curriculum. Finally, this emphasis develops the base needed to keep abreast of the rapidly developing science and technology of management.

Although the emphasis on concepts and theory continues throughout the program, and should continue into the period of professional practice, the proportionate stress on the application of these foundations is steadily in-

creased. The Duke M.B.A. places emphasis on converting concepts and theories of the sciences into managerially useful administrative technology.

The particular focus on concepts and theory is planned to produce a special flexibility in the career of the Duke M.B.A. By examining problems to discover their underlying structure and by designing solutions to fit that structure, the student develops the flexibility to do two very important things. The first is to identify the common form of problems that in many respects appear to be different. This permits learning to be very efficient by giving each lesson learned the flexibility required for application to many apparently different problems. The second is to grasp very quickly the essential nature of tasks or positions with which experience is quite limited. This permits effective performance in the variety of positions needed to develop maximum professional potential.

To achieve this flexibility, the Duke M.B.A. student devotes the first three semesters to development of the managerial theory and tools of analysis needed as a foundation for the specialties which are offered and for later professional advancement. Through this approach, each student is prepared for advanced work in any of the elective fields and is able to avoid a rigid commitment to any one field of study or practice. Hence, through thorough preparation in the concepts and theory that underlie the full range of managerial fields, the student becomes, as much as possible, flexible and independent of a single line of opportunity.

MASTER OF BUSINESS ADMINISTRATION CURRICULUM

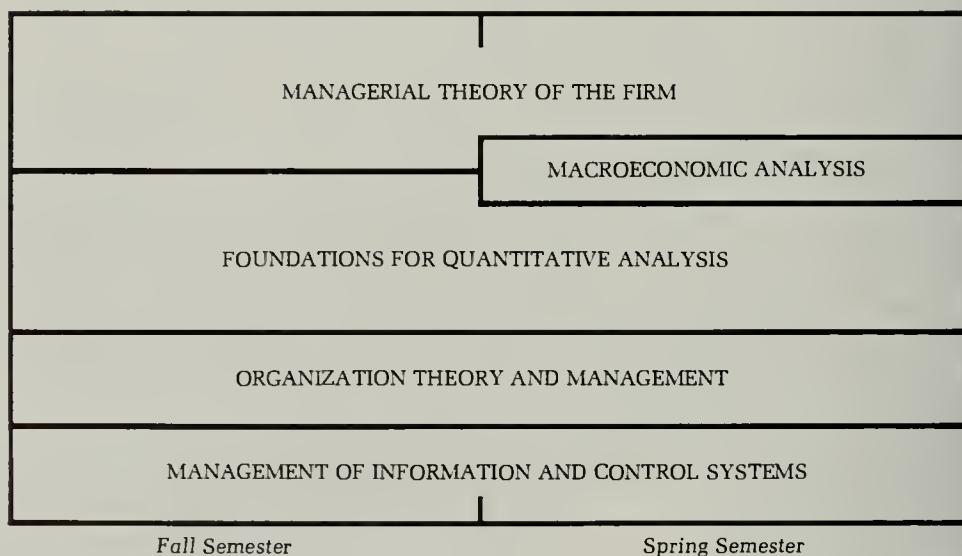
The M.B.A. requires four semesters of full-time work, totaling 64 semester hours of graduate course credit. Because the Duke M.B.A. program is so different from most undergraduate work in business administration, only on rare occasions will a student be able to substitute more advanced work for one or more core courses, and this is more likely in mathematics than in other subjects. In the summer between the first and second years, the M.B.A. student is expected to gain practical experience through related employment, and approximately seventeen weeks between the spring and following fall semesters are scheduled for this experience. This period, aside from its obvious financial



benefits, aids the student in his selection of an area of study for his practicum, which is part of the second year's work. In many cases, the student will select a topic for his practicum during the summer.

First Year Program. Course work for the first year of the M.B.A. program provides the basic knowledge required to understand and to analyze the operations of a firm in a market economy. The topics are arranged to reinforce the knowledge gained in one course by subsequent use in other courses. The sequence also permits basic assumptions, developed in a tight, theoretical structure in one area, to be related and examined in subsequent work in other areas.

The courses are organized to consider problems from the functional areas of marketing, production, finance and personnel, and to develop the supporting and controlling tools of analysis. These include mathematics and statistics, accounting, management information systems, and control mechanisms. The individual courses consider problems that are similar in their form so that major tools of analysis and approaches to problems can be learned in their generic patterns for application to each of the appropriate specific problems. Students should view the curriculum as a set of experiences whose design is an illustration of some of the major lessons it teaches.



First Year Courses

300. Managerial Theory of the Firm I. Develops the fundamental theory of the firm on which analysis and planning of operation of the economic enterprise is based. Competitive price and non-price behavior in single and multiple market segments, cooperative market behavior, and production are examined through classical economic theory and its modern extensions. Emphasis is on optimal decisions and formulation of economic strategy within the market economy. 5 units.*

301. Managerial Theory of the Firm II. Optimal planning of the firm's operations through development of models of the firm in which decision vari-

*One unit is equivalent to one semester hour.

ables are production levels, inventory levels, operating budgets and capital budgets, for both certainty and uncertainty situations. The development and theoretical analysis of the models involve linear economic models, linear programming models, integer programming models, and the von Neumann-Morgenstern expected utility hypothesis for decision-making under uncertainty. 4 units.

310. Foundations for Quantitative Analysis I. Considers mathematical structures which are useful models for subsystems of an economic enterprise. The structures considered provide the framework for understanding and analyzing complex organizations and economic events, and develop problem-solving tools and techniques. This course and B.A. 311 provide the mathematical and statistical background beyond beginning calculus required in the M.B.A. program. The major topics are: sets, relations, and functions; introductory probability theory; linear algebra; classical optimization techniques; and introduction to linear programming. 5 units.

311. Foundations for Quantitative Analysis II. Continuation of B.A. 310. The major topics are: probability, statistical decision theory, sampling theory, estimation and hypothesis testing, and regression and correlation analysis. 4 units.

320. Management of Information and Control Systems I. The financial accounting model is developed as a critical subset of the general information system of the firm. This initial model is extended through consideration of general systems theory to encompass the economic and organizational models of the firm developed in B.A. 300 and B.A. 330. 3 units.

321. Management of Information and Control Systems II. The classical cost accounting model is developed and then restructured to provide data for planning and control of complex enterprises through use of modern managerial technology. This includes design of an information system that provides the data needed for advanced economic and organizational models of the firm. 3 units.

330. Organization Theory and Management I. Design, coordination, and control of the modern business corporation. The essentials of cybernetics, information economics, and team theory are developed. This theoretical foundation together with neoclassical theory of the firm are applied to the solution of the following classes of problems: design of transfer pricing and other incentive systems for coordination; design of systems for collecting and disseminating information for decision-making throughout the firm; design of budgeting procedures and other systems for internal resource allocation; and critical evaluation of special solutions to the short-run control problem, such as "management-by-exception." Written cases and computer-based business games, where appropriate, are used to illustrate applications of theory to practical situations. 3 units.

331. Organization Theory and Management II. The theory of adaptive control systems in organizations, begun in B.A. 330, is developed further. A theory of goal formation and structural change is developed and applied to an analysis of the long-run development of major corporations in such a way that the historical lessons are transferable to current and future problems in organization change. Recent psychological and sociological theories of individual and small group behavior are critically reviewed in light of the cybernetic framework developed earlier. Given these new macro and micro level perspectives, the organization design problem, treated in B.A. 330, is recon-

ceptualized, and computer simulation models of organization behavior that incorporate these new perspectives are examined. The student is encouraged to use the computer to explore his own variations of these basic models. 3 units.

341. Macroeconomic Analysis. Focuses on understanding the determinants of price level, rate of growth, and level of aggregate income, employment, and output in the economy. The purpose is to develop an understanding of the rationale of government policies and the impact of governmental behavior on the national aggregates and, in turn, the effect of these factors on the level of activity in the various industrial sectors. 2 units.

Second Year Program. The primary thrust of the third semester's work is toward more advanced analysis of how the firm should relate its internal and external plans and actions. The external relationships can be classified into those which are competitive, those which are cooperative, and those which have characteristics of both. The internal relationships include the planning and control of manufacturing and financial operations. The advanced tools of analysis, conceptual structure, and legal constraints needed to work with these complex relationships are developed.

The final semester of the M.B.A. program builds upon the foundations laid during the first three semesters. This work is directed toward understanding and solving actual problems of the firm, using the tools of analysis and the conceptual framework developed earlier. The schedule provides for a two-week period when there are no classes, in order to give time for concentrated work on the practicum and to interview potential employers.

OPERATIONS RESEARCH		PUBLIC POLICY OF THE FIRM	
COOPERATIVE DECISIONS AND COMPETITIVE STRATEGIES	COOPERATIVE-COMPETITIVE RELATIONS AND DECISIONS	ELECTIVE	
		ELECTIVE	
LAW AS A CONSTRAINT FOR BUSINESS		PRACTICUM	
Fall Semester		Spring Semester	

Second Year Courses

312. Operations Research. Deals with development of mathematical models of various aspects of economic operations, including topics in the areas of queuing, inventory, and maintenance. General procedures for the solution of mathematical problems involving the identification of maxima and minima are studied along with simulation and the use of the computer for the generation of solutions. 4 units.

302. Cooperative Decisions and Competitive Strategies. Deals with the problems of choosing cooperative economic relations in order to effect exchange transactions, and the problems of determining competitive behavior. The efficiency and stability of various forms of cooperative vertical market structure under simple competitive conditions are rigorously studied. Competitive market decisions are studied in the context of the formulation and solution of purely competitive market games. Although the more advanced and rigorous portions of the course are mathematical and theoretical, increasing emphasis is focused on the practical applications to markets and the development of realistic combination of cooperative and competitive programs. 4 units.

332. Organization Design and Internal Operations. Design of organizations for coordination and control of the internal operation. The topics include: (a) specialization, both functional and hierarchical, with particular attention to the problems of decomposition and decentralization; (b) coordination, including cost-benefit analysis of alternative means of coordination; and (c) control, with emphasis on the role of information systems and the design of decision rules. These topics are examined for the organization in general, but with specific reference and application to the production and finance segments. 4 units.

303. Cooperative-Competitive Relations and Decisions. A simultaneous treatment of the firm's decisions on its cooperative and competitive behavior, and on the design of its internal structure and its production and financial operations. The subject of the course is the firm's coordinated treatment of the decision variables which reflect its direct relations to the economic units with which it cooperates and competes to effect exchange transactions, and those which relate to the form of its internal operations and organizational structures. 2 units.

349. Law as a Constraint for Business. Considers the major legislation, court cases, and regulations of federal agencies which constrain the area within which the firm must operate, including aspects of the commercial code, anti-trust law, and labor and fair employment law. 2 units.

350. Public Policy of the Firm. Focuses on analysis of the relationships between the firm and the three segments of society: the public at large, the organizations and individuals in close contact with the firm, and the members, or employees, of the firm. Primary emphasis of the other parts of the M.B.A. program is on design and decision, oriented to reach the goals of the firm. This course treats some of the problems involved in selecting the ends and restraints from among feasible alternatives; i.e., the problems of developing a policy of the firm toward the society of which it is a part. 3 units.

390. The Practicum. The Practicum is individually designed and is a major component of the second-year program designed to give the student a significant experience in applying the concepts, theories, and methods of analysis he learns in the program to a real, complex problem of an economic enterprise. It should include the analysis of the real situation and the explicit formulation of the problem. That is, the problem which the student treats in the Practicum should not be described with only the solution left to be developed. The important task of identifying and specifying the actual problem, perhaps after being directed to correct some undesirable symptoms, is an integral part of the Practicum.

The Practicum report should propose a solution to the problem specified and should contain the explanation and logic that supports those recommenda-



tions. This solution should be one that can be implemented and must not ask for human or nonhuman resources unavailable for use in the proposed solution. Further, where the solution of the problem is sensitive to the assumptions made, those assumptions must be realistic. The Practicum is supervised by one of the two professors teaching the electives selected by the student. 5 units.

313. Advanced Operations Research. Deals with problems of organization for an operations research project, formulation of the problem, model construction, interpretation of analytical results, and implementation. Selected cases of particular applications of operations research from the literature serve as a basis for much of the class work. Students work in local industry, the University, the medical center, or in other cooperating agencies on operations research problems. Methodologically, some attention is devoted to advanced solution techniques as necessary to complete student projects, but primary attention is focused on formulation and use of models, the modification of existing models, or development of new ones. 4 units.

323. Controllership. Develops systems for collecting and summarizing data in a manner which meets the requirements of the management team in controlling and planning operations. The function of the controller, as the center of synthesis and analysis of data, is studied in the context of the foundations established during the first three semesters. 4 units.

324. External Reporting and Auditing. Builds on the information systems sequence of the first year and the public policy course, in terms of developing requirements of the system for reporting to parties external to the firm who have need for information about the activities of the enterprise for decision-making purposes. Communication and measurement problems as well as the role of the independent auditor in developing evidence of and attesting to the reliability of data are studied in detail. 4 units.

333. Manpower Planning and Management. An application of behavioral and economic theories and of quantitative techniques to management of the firm's human resources, including treatment of both labor and management personnel. Detailed examination of American occupational structure (e.g., mobility patterns, increasing specialization, and professionalization) and

analysis of the labor union as an institution are included. Topics studied within the constraints of industrial, educational, and labor institutional structure are: employee testing, selection and assignment, training and development, performance evaluation and optimal incentive systems, strategic and tactical factors in collective bargaining. 4 units.

351. Finance. Focuses on management of the financial affairs of the firm, in its attempt to develop an optimal capital structure, and includes: (1) the sale of corporate securities of all varieties and the related knowledge about the requirements of investors at particular points in time, and (2) the translation of plans and programs into needs which must in turn be met by cash resources from either internal or external sources. 4 units.

353. Marketing. Applies the general theories previously studied to the firm's marketing problems. Definition and resolution of these problems involve a more detailed discussion of the existing market environment of the firm. Problems studied are those of consumer behavior, marketing structures, product planning, pricing, promotion, logistics, and marketing research. 4 units.

355. Production. Provides the student with experience in applying the theories developed during the first three semesters to problems of professional practice in the area of production management. Two major problem areas are covered, the design (or planning) of manufacturing systems and their operation (or control). Sub-topics under design include plant layout, economic evaluation of materials, methods and processes, facilities planning. Sub-topics under operation include cost, inventory and quality control, short-run scheduling and capacity utilization, maintenance, start-up problems, and equipment replacement. 4 units.



The M.B.A.-J.D. Program

The Schools of Law and Business Administration offer a combined M.B.A. and J.D. program that can be completed in four academic years of work. The first two years are allocated to a full year in each program in either sequence. The latter two years are devoted to an integrated program that meets the requirements for completion of both the M.B.A. and J.D. Both degrees are awarded upon successful completion of the combined program.

To apply for admission to this program, application for both the M.B.A. and the J.D. programs is required. Additional information about the program and application procedures may be obtained on request from the Director of Admissions of the Graduate School of Business Administration.

The Master of Science in Management

For some students, combining graduate study with work experience provides more effective professional development than full-time study. The Duke Master of Science in Management Evening Program serves this need by offering a sound education in management, and, at the same time, allowing the student to continue in a managerial or administrative position.

The overall purpose of the Master of Science in Management Program is to contribute to the growth and development of promising managers as they attempt to improve the performance of the organizations in which they work. Emphasized in the program are the common form of problems within the several segments of the organization and the interrelationships among solutions to problems. This area of study enhances the manager's capacity to identify the essential variables in a problem and to distinguish between the common form among problems and the uniqueness in any specific case. In addition, students are taught modern tools of analysis to be used in understanding and solving problems.

This background in management—emphasizing foundations, concepts, and the modern tools of analysis—improves the manager's ability to learn from events in his environment and to do so in an integrated, orderly manner.

Completion of the program requires approximately twenty months of study, with classes being held on Monday and Thursday each week from 5:00 to 9:00 p.m. Additional information about the curriculum is available on request.

Application credentials are identical to those for the M.B.A. program. The only specific course prerequisite is one year of the calculus, but applicants are expected to hold full-time positions and to continue in them while enrolled in the program.

The Doctor of Philosophy

The objective of the Ph.D. program is to prepare candidates for academic or business careers, and places primary stress on development of the capability to engage effectively in research related to the management of complex organizations.

Courses. One year of study (30 semester hours) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should include two courses in advanced economic theory, two courses in mathematics or statistics, and a set of three individually de-



signed courses in an elected field of administration. These courses, which are offered on a tutorial basis, may cut across traditional disciplinary boundaries in a manner that integrates these disciplines.

Research Tools. Satisfactory preparation in a research-tool area is required. Reading knowledge in one foreign language is accepted as meeting this requirement. An alternative is advanced study in some other discipline approved by the faculty of the Graduate School of Business Administration, the Executive Committee of the Graduate Faculty, and the Dean of the Graduate School.

Preliminary Examinations. Economic theory, quantitative methods, and the elected field of administration are the areas covered by the preliminary examinations. Normally, students are expected to take these examinations following the completion of required course work and the research-tool preparation.

Doctoral Dissertation. The doctoral dissertation is expected to be original research in some area of theory, analytic methods, or administrative application related to improvement of the performance of economic organizations. The main purpose of the dissertation should be to contribute to scientific knowledge pertinent to management of organizations.



2

Admission and Financial Information

Admission

Applicants for admission to the Duke M.B.A. program should have earned a baccalaureate degree with a sufficiently good record of performance to demonstrate the ability to engage in rigorous analysis. Neither prior business experience nor undergraduate study in business administration is necessary, but prior experience in business, government, or other organizations is viewed favorably. The M.B.A. program is designed to accept undergraduate majors from a broad range of disciplines, including the physical, biological, and social sciences, engineering, mathematics, philosophy, and humanities.

The only specific course prerequisite for admission is one year of calculus at the college level. If an applicant is deficient in this requirement, he may take the requisite mathematics courses in Duke University's Department of Mathematics during the summer, but courses at any college or university are acceptable for meeting the requirement.

Both admission and financial aid decisions are made to encourage students from all races, religions, national origins, and both sexes to matriculate in the Graduate School of Business Administration. Admission is based on merit, and special recognition is given to the difficulty in using traditional credentials in estimating merit of applicants from some minority group experiences.

Application Information. Applicants may submit any information about their academic or work performance in support of their application. Information of greatest value is that which supplements the required documents and completed forms in the process of estimating how well the applicant will do in the program and how well the program will prepare the applicant to achieve his own professional goals.

The minimum application credentials are:

1. A completed application form.
2. Two copies of all current transcripts from schools attended.
3. Before matriculation, two copies of final transcripts from each school attended.
4. Personal and professional recommendations.
5. Score on the Admission Test for Graduate Study in Business.
6. No fee is required to complete the application, but a non-refundable tuition deposit of \$25.00 is required at the time of acceptance to the program.

Application Deadlines. An early admissions policy is followed in the Graduate School of Business Administration, and admission decisions are made as applications are completed. Normally, students should complete the application by March 1. Ten percent of the positions in entering class are reserved for late admission in the latter part of the spring and summer.

Admission of Foreign Students. Fully qualified students from outside the United States are welcome at the Graduate School of Business Administration. They are encouraged to pursue normal degree requirements but may also be admitted for non-degree course work if the length of their stay in the United States does not permit time for the completion of a degree. In applying for admission, the foreign student should submit, in addition to the credentials required of all students, the following:

1. If his native language is not English, certification of ability to use English through scores on tests provided by the Educational Testing Service (TOEFL).
2. A statement certified by a responsible person that his finances are sufficient to maintain him during his stay at Duke University. (See the section below on tuition and other costs.)
3. A statement by a qualified physician describing the physical and mental health of the applicant.

Notification of Status. When the applicant has been accepted, he will be sent a letter of admission and an acceptance form. The process of admission is not complete until the statement of acceptance and the \$25.00 tuition deposit have been returned to the Director of Admissions, Graduate School of Business Administration.

Successful applicants will be offered either full admission or provisional admission. Provisional admission is offered to students who warrant admission but who need additional time to complete admission requirements. In each case, the requirements must be met before matriculation.

Admission Test for Graduate Study in Business. The Admission Test for Graduate Study in Business, required of all applicants, is administered by the Educational Testing Service for a fee of \$10. Detailed information about the test and application forms may be obtained by writing directly to the Educational Testing Service, Box 966, Princeton, New Jersey 08540.

The examination is administered at many centers throughout the United States and abroad. Arrangements to take the test at an established center must be made two weeks before the test date (six weeks at established foreign centers). The examination is given in November, February, April, and July. Special centers may be arranged for persons distant from established centers. Requests for such accommodations must be made at least three weeks prior to the selected test date. Fellowship applicants should take the test in November or February. Other applicants may take it as late as April, but the earlier dates are strongly recommended.

Financial Information

The forms of financial aid range from fellowships that provide both tuition and stipend to special loan programs. Several combinations of these two forms of financial aid are available and are awarded primarily on the basis of merit with financial need as an important factor in determining the amount of award or loan. The problems involved in evaluating the traditional credentials of some minority group applicants are given special attention.

Two loan programs are available: (a) the Federally Insured Loan Program and (b) the Deferred Tuition Loan Program. Duke University participates in the Federally Insured Loan Program which permits the student to borrow funds for educational needs up to a maximum of \$2500 per year with a maximum of 10 years to repay after graduation. The Deferred Tuition Loan Program of the Graduate School of Business Administration is a loan program which permits the student to make tuition payment over periods ranging from two to thirty years.

Payment is based on a percentage of gross taxable income, with special arrangements for early payment. Detailed information, payment schedules, and application forms for both programs are available upon request.

A small number of assistantships are available for students during their second year of graduate study. These are granted on the basis of the specific skills needed for the research projects in the School.

Financial Aid Application. Financial aid decisions are made as applications are completed, with the first awards being granted about March 1. To be considered for the full range of awards, applicants should complete both admissions and financial aid applications for fellowships and/or loans early. On the other hand, several awards are reserved for a late decision on those applications which reasonably could not have been submitted early.

The Duke Graduate School of Business Administration is a participant in the Graduate and Professional School Financial Aid Service (GAPSFAS). All applicants for financial aid must file a GAPSFAS form entitled "Application for Financial Aid for the Academic Year 1974-75." The GAPSFAS application may also be obtained from the Graduate and Professional School Financial Aid Service, Box 2614, Princeton, New Jersey 08540, and should be filed no later than February 1 in order to assure its receipt at Duke by March 1. It contains sections to be completed by the applicant, by the spouse or spouse-to-be, and by the applicant's parents. The student must complete the applicant and spouse sections to be considered for aid, fellowship or loan, at the Graduate School of Business Administration at Duke University.

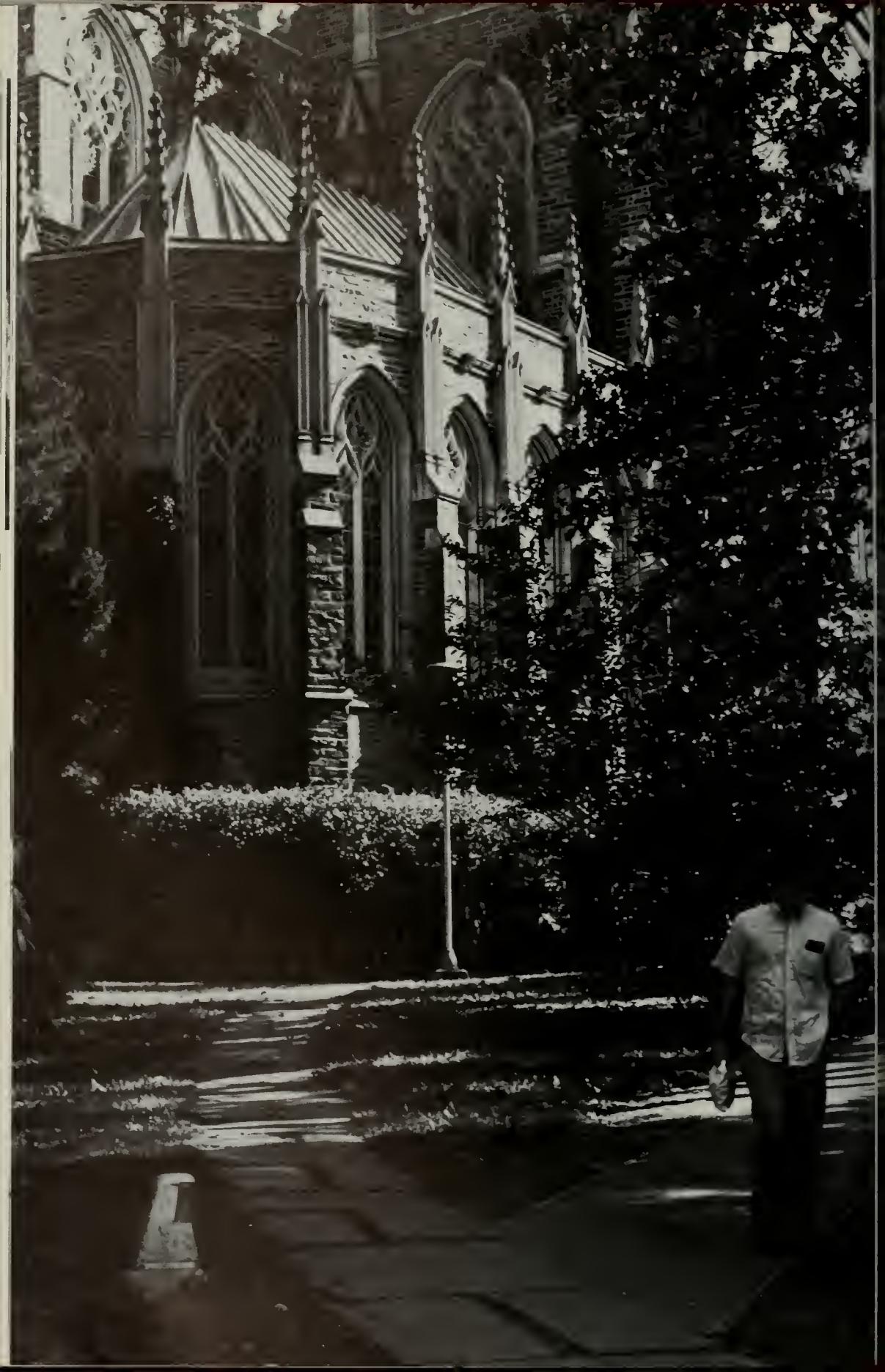
Any questions should be addressed to the Director of Admissions, Graduate School of Business Administration, Duke University, Durham, North Carolina 27706.

Tuition and Other Costs. The following table shows tuition and fees for students in the Graduate School of Business Administration for the year 1974-75. All charges for each semester are payable at the time of registration for that semester, and are subject to change without notice.

Tuition (full semester program of 16 units)	\$1250.00
Optional Annual Athletic Fee (not including federal tax)	25.00
Late Registration Fee	10.00
Doctoral Candidates Fees	
Dissertation Binding Fee (3 copies)	15.00
Dissertation Microfilming Fee	25.00
In Absentia Fee (1 unit per semester)	72.00

After the day of registration, no refund of tuition will be made except for involuntary withdrawal to enter the armed forces or in accordance with established University policy.

Annual expenses vary according to individual tastes, especially for family support, food, recreation, travel, and clothing. Estimates of normal, basic annual expenses should include \$2,500 for tuition, approximately \$200 for books, and a minimum of \$371 for living accommodations.



3

General Information

The University

The James B. Duke Indenture of Trust of 1924 provided the means to transform a small, church-supported undergraduate college into a university of recognized quality among major American Universities. The Indenture identified the need to include a School of Business among the professional schools of the University. In 1969, the Graduate School of Business Administration was added to the professional schools of Law, Medicine, Engineering, Divinity, Nursing, and Forestry.

Students at Duke number 8,450 of whom 2,750 are enrolled in graduate-professional programs. The balanced size and close, informal association among professional schools and related areas of study provides an exceptional opportunity for graduate students to benefit from strengths throughout the University.

The Campus. The Duke campus is located in Durham, North Carolina, a metropolitan area of approximately 100,000 people near the center of the state. Duke is an integral part of the growing Research Triangle of the Piedmont section of North Carolina. The Triangle, an education-research complex, encompasses the resources of the several universities in Durham, Raleigh, and Chapel Hill. These cities provide opportunities and facilities for off-campus cultural, recreational, and social activities. The campus is also within a few hours of the mountains and beaches, providing outstanding skiing, swimming, boating, and other outdoor recreational activities.

The Library. The William R. Perkins Library is located opposite the Graduate School of Business Administration. The G.S.B.A. Reading Room and most of the collections from the basic disciplines related to management are in the Perkins Library. In addition to the two-million volume collection available there, students have access to Duke's Law and Engineering Libraries.

Computing Facilities. The Duke University Computation Center is intended to provide the University faculty and students with a facility for research and instruction in computing. The Center is presently equipped with an IBM 360 Model 40 which is connected by high-speed lines to an IBM 370 Model 165 located at the Triangle Universities Computation Center in the Research Triangle Park. Of special interest to graduate business students, a medium speed terminal with associated slow speed terminals for interactive computing is adjacent to the Business School. These are the terminals most used by M.B.A. candidates for access to the Model 165.

Office of Placement Services. Duke University provides placement services for students and alumni. On-campus interviews for permanent or summer employment are arranged with a broad spectrum of American industry for those persons who register with the Office of Placement Services. It is expected that all students enrolled in the second year of the M.B.A. program will make their off-campus interview trips during the spring holiday which normally occur during the last week of February or the first week in March.

Living Accommodations. Duke University maintains living accommodations for single graduate students.

Rooms in residence halls, spaces in Town House Apartments, or other rental units may be reserved by single applicants after acceptance by the Graduate School and after a \$50 deposit has been paid to Duke University. Assignment priority is established by the date of receipt of completed housing appli-



cations with deposits in the Office of the Director of Housing Management. Regulations governing room and security deposits and occupancy of rooms and apartments will be provided by the Office of Housing Management at the time housing application forms are forwarded to accepted students. Occupants within each type of housing are expected to comply with the appropriate regulations.

Double-occupancy rental charge in the Graduate Center and in the Hanes Annex is \$371 per academic year. Town House Apartments, between East and West Campuses, include thirty, two-bedroom units, each furnished for three graduate students. Two students occupy the master bedroom; the third occupies a smaller bedroom. A living room, kitchen, and one and one-half baths complete these comfortable, tastefully appointed living units. The rental rate is \$670 per person for the academic year.

The Department of Housing Management is prepared to assist married graduate and professional students in locating suitable housing in Durham. There are many relatively new complexes and a few older apartments. Houses and complex units are available in limited numbers from time to time.

Accepted applicants to the Graduate School of Business Administration will receive a packet of housing information upon return of acceptance of admission to the Graduate School. The form used for this purpose is sent to applicants with notification of acceptance to the program.

Food Services. Food service is available on both the East and West Campuses. The dining facilities on the West Campus include cafeterias and a table service dining room where full meals and *a la carte* items are served. The Graduate Center has a cafeteria open at meal hours and a coffee lounge which is open until 11:00 p.m.

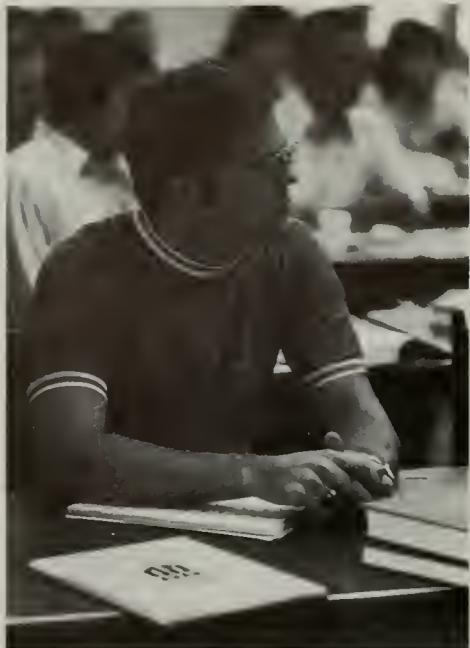
Because of the large numbers served in the dining halls, it is not possible to arrange special diets for individual students. The cost of meals approximates \$2.75 to \$3.50 per day, depending upon individual tastes.

Standards of Conduct. Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct. The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as currently in effect or, from time to time, are put into effect by the appropriate authorities of the University.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University.

Motor Vehicles. Each member of the Duke academic community possessing or maintaining a motor vehicle at Duke University is required to register it with the University. Students do so annually at the beginning of the fall semester. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, it must be registered within five calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of \$10 for each automobile and \$5 for each two-wheeled vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least \$10,000 per person and a \$20,000 per accident for personal injuries.



and \$5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

Medical Care. The aim of the University Health Service is to provide medical care and health advice necessary to help the student as a member of the University community. The main components of the Health Service include the University Health Services Clinic located in the Pickens Building on West Campus and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the Insurance Plan.

The resources of the Duke University Medical Center are available to all

Duke students and their spouses and children. Charges for services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the Clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultations or medical treatment to be paid for by the student or covered by the Insurance Plan. Facilities of the University Health Services Clinic are available during both regular and summer sessions to all currently enrolled full-time students. To secure the benefits of these services a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until the student has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students in residence. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined in the Infirmary. Hospitalization in Duke Hospital or other hospitals must be covered through private insurance policies or the Duke Student Accident and Sickness Insurance Policy. Financial responsibility for expenses incurred in the Emergency Room rests with the student.

The Student Mental Health Service, which is located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Students may have up to four appointments with the Student Mental Health Service staff at no charge. Further interviews can be arranged, either with members of the Student Mental Health Service staff or with a variety of other local resources at a fee commensurate with the student's ability to pay.

The University has made arrangements with the Mid-South Insurance Company for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve month period. The 1973-74 rate is \$32.90 per student. For additional fees a student may obtain coverage for a spouse or spouse and child. Participation in this program is on a waiver basis. The University expects all students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may waive the Duke Plan by signing a statement to this effect. Each full-time student in residence must purchase this student health insurance or sign a waiver before his registration is complete. The Student Accident and Sickness Insurance Policy provides protection 24 hours per day during the full 12-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the policy is from August 31. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage. Information concerning this policy may be obtained from the Dean of the Graduate School of Business Administration.



Faculty of the Graduate School of Business Administration

The faculty has grown from a planning group of four members in 1967 to a group of eight members in 1970 when the first class of students entered the M.B.A. program, and then to a group of eighteen members in 1973. Several members will be added each year until the faculty includes thirty-five members.

The student-faculty ratio in the School is maintained at a level permitting development of close professional relationships and encouraging individual assistance in academic and professional development. The student-teaching faculty ratio in the M.B.A. program has been about 7 to 1 and will continue at that level. In addition, faculty engaged in major research projects and other teaching assignments are available to participate with M.B.A. students. This balance is very attractive for both students and faculty in their joint work toward maximum professional development of the M.B.A. candidate.

The faculty, the universities in which they received their formal education, their academic rank, the main areas of interest follow:

**Carole A. Aldrich, B.S., M.S.I.A., Ph.D., Assistant Professor of
Business Administration**

B.S. (Industrial Management), M.S.I.A., Ph.D. Carnegie-Mellon University. Economic models of the firm with special interests in the theory of dynamic problems. Public Policy.



**Kenneth R. Baker, A.B., Ph.D., Associate Professor of Business
Administration**

A.B. (Engineering and Applied Physics), Harvard College; Ph.D. (Operations Research), Cornell University. Operations research, production planning, scheduling, and control.





Helmy H. Baligh, B.A., M.B.A., Ph.D., Professor of Business Administration

B.A. (Philosophy, Politics and Economics), Oxford University; M.B.A., Ph.D. University of California at Berkeley. Market theory and the design and control of general competitive and cooperative strategies. Analysis and design of vertical market structures (channels of distribution) for both business and social purposes.



Joseph Battle, B.S., M.S., Ph.D., Associate Professor of Business Administration

B.S. (Mathematics and Physics), North Carolina Central University; M.S., Ph.D. (Mathematics), University of Michigan. Development and application of mathematics in operations analysis and in information systems.



Richard M. Burton, B.S., M.B.A., D.B.A., Associate Professor of Business Administration

B.S. (Engineering Mechanics), M.B.A., D.B.A. University of Illinois. Systems analysis, operations research, and organization theory with applications to production planning, scheduling, capital budgeting, and design of organizations as a problem in system design.

William W. Damon, B.S., M.B.A., Ph.D., Assistant Professor of
Business Administration

B.S. (Mathematics and Physics), Purdue University; M.B.A.,
Ph.D. (Quantitative Analysis, Finance), Cornell University.
Operations research and integrated planning of production and
inventory, work force, marketing, and cash flow; corporate
financial structure and investment theory.



David C. Dellinger, B.S., M.S., Ph.D., Associate Professor of
Business Administration

B.S. (Mechanical Engineering), Duke University; M.S., Ph.D.
(Industrial Engineering-Operations Research), Stanford University.
The conduct of operations research studies to solve
problems and the implementation of the solutions.



Thomas F. Keller, A.B., M.B.A., Ph.D., C.P.A., Professor of
Business Administration

A.B. (Economics and Accounting), Duke University; M.B.A.,
Ph.D. (Accounting), University of Michigan. Design of accounting
information and control systems for use in meeting require-
ments of external reporting and modern management.





Arthur J. Kuhn, B.S., M.B.A., Ph.D., Assistant Professor of Business Administration

B.S. (Mechanical Engineering), M.B.A. University of Illinois; Ph.D. (Business Administration), University of California at Berkeley. Organization, system, and control theory as applied to the design of performance control systems for complex organizations and the historical and sociological analysis of readily comparable firms exhibiting significant performance differences.



Dan J. Laughhunn, B.S., M.B.A., D.B.A., Professor of Business Administration

B.S. (Engineering Mechanics), M.B.A. and D.B.A. University of Illinois. Production, finance, and operations research with emphasis on dynamic programming, capital budgeting, and long-range planning. Statistics and control theory.



Steven F. Maier, B.S., M.S., Ph.D., Assistant Professor of Business Administration

B.S. (Industrial Engineering), Cornell University; M.S., Ph.D. (Operations Research), Stanford University. Operations research, computer science, finance, and statistical decision theory. Mathematical models of the corporate cash management problem, decomposition as a technique for solving linear models, and the design of a high level computer language.

Russell J. Petersen, B.S., M.S., Ph.D., C.P.A., Assistant Professor of Business Administration

B.S. (Accounting), Oregon State University; M.S. (Accounting and Statistics), University of Oregon; Ph.D. (Accounting), University of Washington. Accounting and information systems with special focus on simulation and the study of measurement models and their impact on investment decisions.



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Helmy H. Baligh, Ph.D., Associate Dean
Thomas F. Keller, Ph.D., Chairman of the Doctor of Philosophy
Richard M. Burton, D.B.A., Director of Admissions



Calendar of the Graduate School of Business Administration

1974-75

August		
	30	Registration
September		
	3	Classes begin
November		
	27	Thanksgiving recess begins
December		
	2	Classes resume
	10	Last day of classes
	11-13	Final examinations
January		
	13	Classes begin
March		
	17	Spring vacation begins
	24	Classes resume—First year students, second year Practicum research
	31	Classes resume—Second year students
April		
	25	Last day of classes
	28-30	Final examinations
May		
	11	Commencement

1975-76

August		
	29	Registration
September		
	2	Classes begin
November		
	26	Thanksgiving recess begins
December		
	1	Classes resume
	9	Last day of classes
	10-12	Final examinations
January		
	12	Classes begin
March		
	15	Spring vacation begins
	22	Classes resume—First year students, second year Practicum research
	29	Classes resume—Second year students
April		
	23	Last day of classes
	26-29	Final examinations
May		
	9	Commencement

MAP OF DUKE UNIVERSITY

East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
D	Union Building
E	Faculty Apartments
F	Art Museum, Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert-Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davson Building School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T, Clinical Research
J	Duke Hospital
K	Sociology, Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle

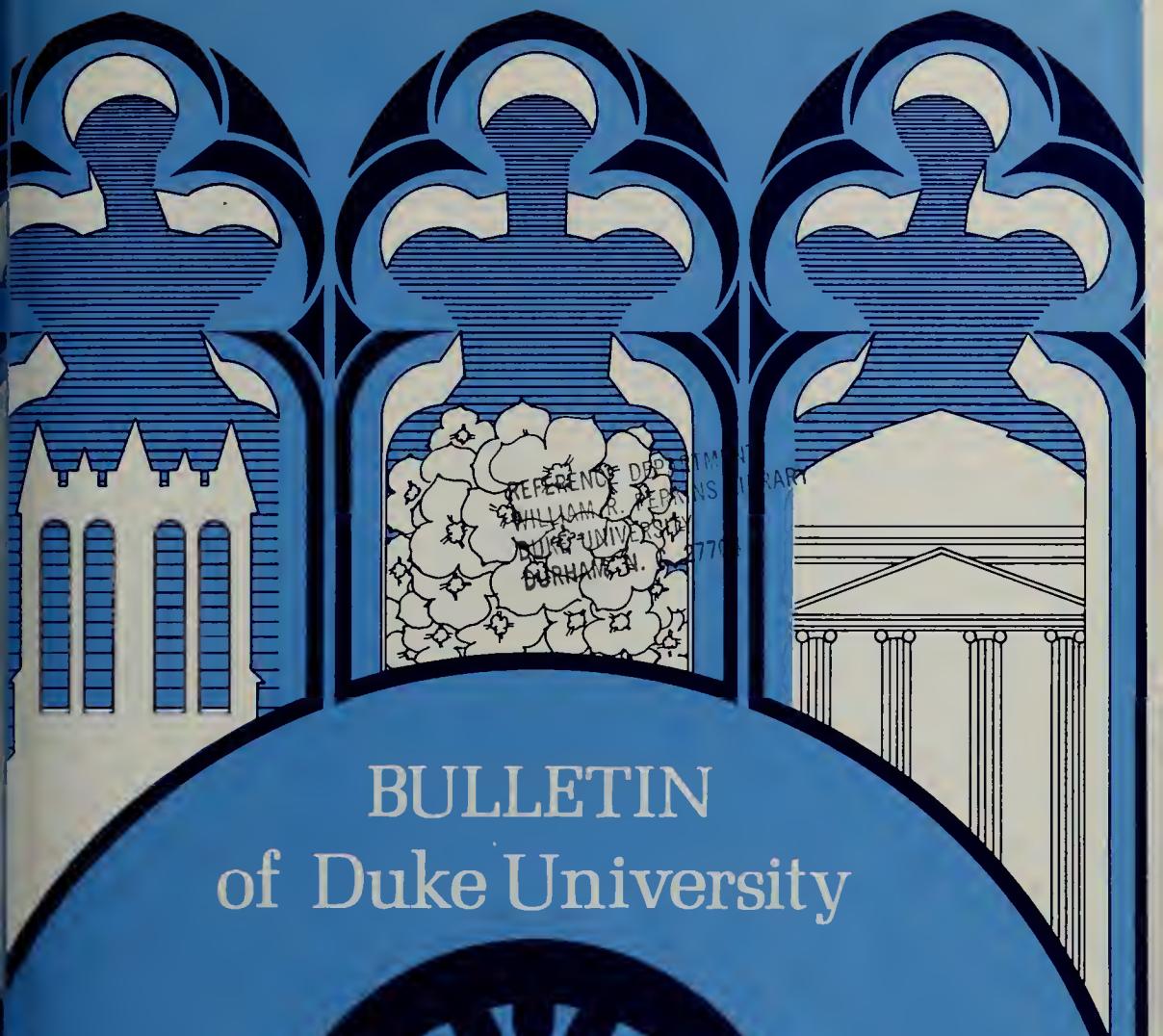
O	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Krigo Quadrangle
T	Union Building
U	Flowers Building
AA	Page Auditorium

V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Laboratories
Z	Biological Sciences
AA	Plant Environment Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Research Buildings
GG	Nanantine H. Duke Medical Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House
KK	School of Nursing
LL	Hanes House Annex
MM	Pickens Rehabilitation Center
NN	Graduate Center
OO	Alumni House
PP	Commonwealth Studies Center
QQ	Personnel Office
RR	International House
SS	Personnel Office
TT	A Better Chance Program
UU	International Studies Center
VV	Campus Stores Office
WW	Office of Institutional Advancement
XX	Information Services
YY	Visitors Bureau
ZZ	Admissions Office





DUKE
UNIVERSITY
BULLETINS



A stylized illustration of a stained glass window divided into three vertical panels. The left panel shows a building with a tower and arched windows. The middle panel contains a floral pattern with handwritten text: "REFERENCE DEPARTMENT", "WILLIAM R. PERIN LIBRARY", "DUKE UNIVERSITY", and "DURHAM NC 27708". The right panel depicts a classical building with columns. The entire illustration is set against a blue background.

BULLETIN of Duke University

1974

1974



SUMMER SESSION

Bulletin of Duke University

Summer Session

REFERENCE DEPARTMENT
WILLIAM R. PERKINS LIBRARY
DUKE UNIVERSITY
DURHAM, N. C. 27706

1974

Durham, North Carolina 1974

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Contents

Calendar of the Summer Session	iv
General Administration	iv
Offices of the Summer Session	v
The Summer Session Faculty	v
1 General Information	1
2 Program Information	3
Undergraduate Study	3
Divinity School Studies	3
Graduate Study	3
Postdoctoral Research	5
3 Special and Cooperative Programs	7
Cooperative Program	7
Special Conferences and Courses	7
4 Resources for Study	11
5 Student Life	13
Living Accommodations	13
Services Available	14
Student Activities	17
6 Admission	19
7 Financial Information	23
Tuition and Fees	23
Living Accommodations	24
Student Aid	26
8 Registration and Regulations	29
Academic Regulations	32
Motor Vehicle Regulation	35
9 Courses of Instruction	37
Applications	71

Calendar of the Summer Session

1974

First Term: May 14-June 15

Second Term: June 17-July 17

Third Term: July 18-August 17

May

- 10 Friday—Completion of registration for Term I
- 13 Monday—Noon, dormitories ready for occupancy
- 14 Tuesday—First class day except for undergraduate courses in chemistry and physics
- 15 Wednesday—Final date for completing application for admission to the Graduate School for Term II of the summer session
- 18 Saturday—Classes will be held
- 20 Monday—First class day for chemistry and physics

June

- 10 Monday—Final date to register for English examination. Registration is taken in the Graduate School Office. This examination is open to students eligible to use English as a foreign language
- 14-15 Friday-Saturday—Final examinations for Term I
- 14 Friday—Completion of registration for Term II
- 14 Friday—Final date for completing application for admission to the Graduate School for Term III of the summer session
- 14 Friday—Examination for students electing English for a foreign language requirement; room and hours to be announced
- 17 Monday—First class day for all courses in Term II

July

- 12 Friday—Examination for undergraduate courses in chemistry and physics, Term II
- 16-17 Tuesday-Wednesday—Final examinations for Term II
- 17 Wednesday—Completion of registration for Term III
- 18 Thursday—First class day for Term III

August

- 1 Thursday—Final date for filing with the Graduate School Office the Statement of Intention to complete requirements for an advanced degree during the summer session. If a thesis is to be presented, the title is to be filed at the same time as the Statement of Intention
- 15 Thursday—Last day for submitting theses for advanced degrees
- 16-17 Friday-Saturday—Final examinations for Term III
- 17 Saturday—Final date for completion of requirements for Graduate School degrees to be awarded September 1

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Officers of the Summer Session

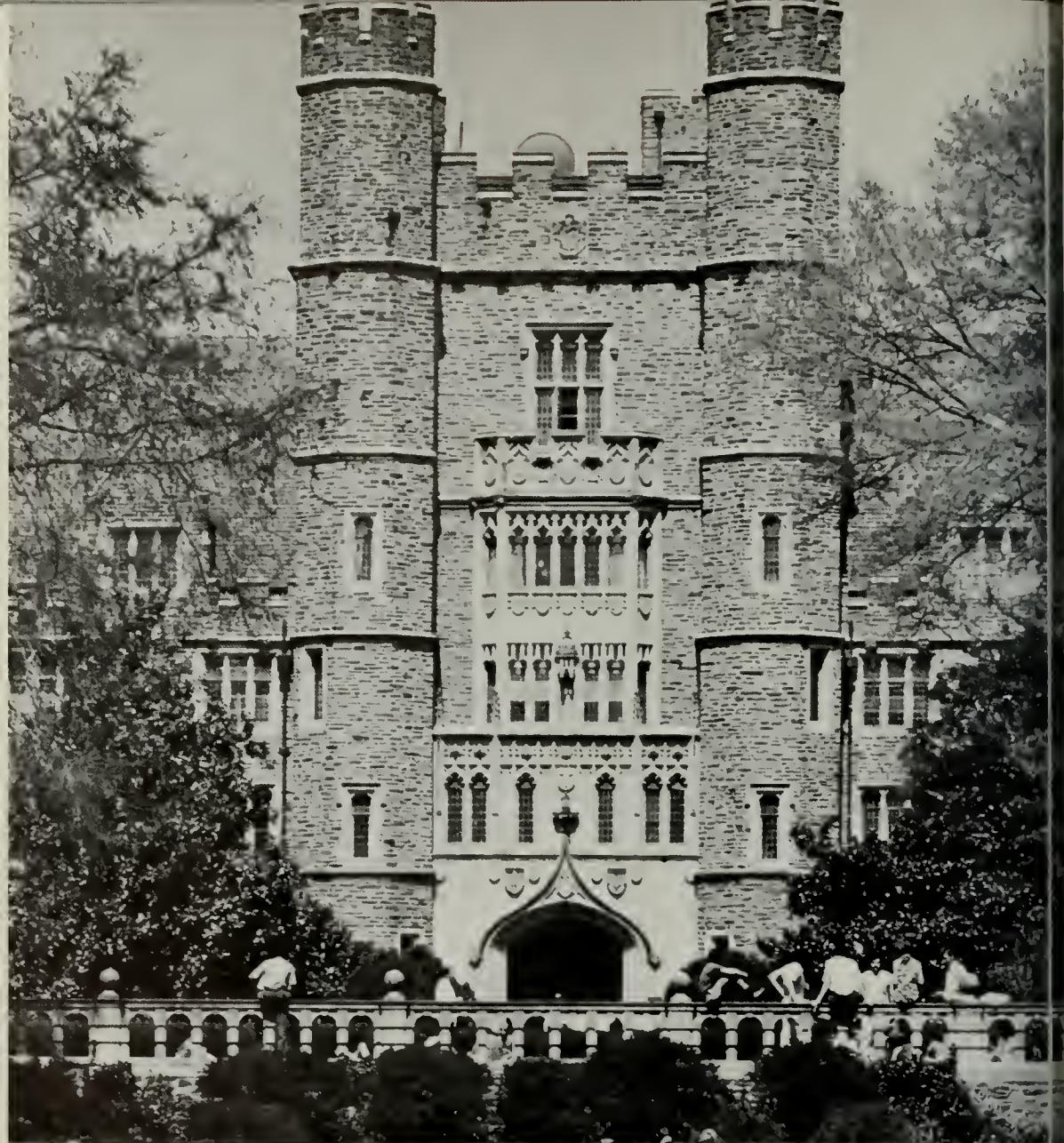
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Wesley Kort, Ph.D., Acting Assistant Provost and Acting Associate Dean of Trinity College of Arts and Sciences
Walter G. Emge, Ph.D., Assistant Dean of Trinity College of Arts and Sciences
Stephen C. Frederic, B.D., Assistant Dean of Trinity College of Arts and Sciences
Virginia S. Bryan, Ph.D., Assistant Dean of Trinity College of Arts and Sciences
David S. Clayborne, M.A., Assistant Dean of Trinity College of Arts and Sciences
Gerald A. Wilson, Ph.D., Assistant Dean of Trinity College of Arts and Sciences
Ellen W. Wittig, Ph.D., Assistant Dean of Trinity College of Arts and Sciences
Howard Strobel, Ph.D., Assistant Dean of Trinity College of Arts and Sciences
James C. Little, Ph.D., Assistant Dean of Trinity College of Arts and Sciences
Elizabeth Nathans, Ph.D., Assistant Dean of Trinity College of Arts and Sciences
Paula R. Phillips, A.B., Assistant Dean of Trinity College of Arts and Sciences
Richard L. Cox, Th.M., Dean of Students
James Douthat, B.D., Assistant Dean of Students
Lillian A. Lee, M.S.Ed., Assistant Dean of Students
Clarence G. Newsome, B.A., Acting Dean of Block Affairs
William J. Griffith, A.B., Assistant Provost and Dean of Student Affairs
Ruby Wilson, Ed.D., Dean of the School of Nursing
Ella E. Shore, M.A., Dean of Student Affairs of the School of Nursing
Ada Most, Ed.D., Director of Academic Programs of the School of Nursing
George W. Pearsall, Sc.D., Dean of the School of Engineering
Rhett T. George, Jr., Ph.D., Assistant Dean of the School of Engineering
Otto Meier, Jr., Ph.D., Assistant Dean of the School of Engineering
Thomas A. Langford, Ph.D., Dean of the Divinity School
Charles William Ralston, Ph.D., Dean of the School of Forestry
Charles M. Harman, Ph.D., Associate Dean of the Graduate School
Dale B. J. Randall, Ph.D., Associate Dean of the Graduate School
Thomas D. Kinney, M.D., Director of Medical and Allied Health Education
John Costlow, Jr., Ph.D., Director of Duke Marine Laboratory
Jean F. O'Barr, Ph.D., Director of Career and Continuing Education
Robert Young, B.D., Minister to the University
James Benjamin Smith, M.S.M., Director of Chapel Music and Choral Music
Walter Scott Persons, A.B., Recreation Supervisor for the Summer Session
Lawrence W. Smith, Jr., B.A., Director of Housing Management
Paul R. Benton, Manager of Residence Halls
Winifred R. Brogden, Administrative Secretary of the Summer Session
Paul D. Williams, Jr., M.A., Assistant to the Director of the Summer Session

The Summer Session Faculty

Adams, Anne H., Ed.D., Professor of Education
Adams, Richard W., Ph.D., Assistant Professor of English
Alt, Arthur Tilo, Ph.D., Assistant Professor of German
Anderson, Carl L. Ph.D., Professor of English
Aquila, Richard E., Ph.D., Assistant Professor of Philosophy
Auld, Louis E., Ph.D., Assistant Professor of Romance Languages
Baier, Rodger W., Ph.D., Assistant Professor of Chemistry
Bailey, Lloyd R., Ph.D., Associate Professor of Old Testament
Baldwin, Steven W., Ph.D., Assistant Professor of Chemistry
Barber, Richard T., Ph.D., Associate Professor of Zoology
Beecher, Robert, B.A., Instructor in Anthropology
Benditt, Theodore M., Ph.D., Assistant Professor of Philosophy

Bessent, Helga W., M.A., Assistant Professor of German
Black, David E., Ph.D., Assistant Professor of Economics
Bland, Kalmam P., Ph.D., Assistant Professor of Religion
Blankley, William, Ph.D., Assistant Professor of Botony
Bonk, James, Ph.D., Assisting Professor of Chemistry
Bookhout, Cazlyn Green, Ph.D., Professor of Zoology
Borinski, Ernst, Ph.D., Visiting Professor of Sociology
Bradley, David Gilbert, Ph.D., Professor of Religion
Bryan, Anne-Marie, M.A.T., Assistant Professor of Romance Languages
Budd, Louis J., Ph.D., Professor of English
Burdick, Donald S., Ph.D., Associate Professor of Mathematics
Burford, Walter W., S.T.M., Assistant Professor of Religion
Burian, Peter, Ph.D., Assistant Professor of Classical Studies
Butters, Ronald R., Ph.D., Assistant Professor of English
Calkins, Philip, Ph.D., Assistant Professor of History
Carter, Robin, B.A., Visiting Instructor in Anthropology
Cartwright, William H., Ph.D., Professor of Education
Carson, Robert C., Ph.D., Professor of Psychology
Cell, John W., Ph.D., Associate Professor of History
Christensen, Norman, Ph.D., Associate Professor of Botany
Ciompi, Giorgio, M.A., Artist-in-Residence in Department of Music
Colton, Joel S., Ph.D., Professor of History
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Di Bona, Joseph, Ph.D., Associate Professor of Education
Duffey, Bernard S., Ph.D., Professor of English
Durden, Robert F., Ph.D., Professor of History
Eckman, Kenneth E., Ph.D., Assistant Professor of Mathematics
Efird, James Michael, Ph.D., Associate Professor of Biblical Language and Interpretation
Fenton, Stephen, Ph.D., Visiting Professor in Sociology
Fein, John M., Ph.D., Professor of Romance Languages
Fish, Peter G., Ph.D., Associate Professor of Political Science
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Fortune, Ellen G., M.A., Professor of Nursing
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Fowlie, Wallace, Ph.D., James B. Duke Professor of Romance Languages
Friedrick, John A., Ph.D., Professor of Physical Education
Garci-Gómez, Miguel, Ph.D., Associate Professor of Romance Languages
Gehman, Ila H., Ed.D., Associate Professor of Medical Psychology
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Graham, Daniel A., Ph.D., Assistant Professor of Economics
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Jaeger, Boi Jon, Ph.D., Professor of Health Administration
Jeffs, Peter W., Ph.D., Professor of Chemistry
Johnson, Terry W., Jr., Ph.D., Professor of Botany
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Kort, Wesley, Ph.D., Associate Professor of Religion
Kremen, Irvin, Ph.D., Assistant Professor of Psychology

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Levy, Alan, Ph.D., Assistant Professor of Psychology
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Ropp, Theodore, Ph.D., Professor of History
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Salman, Michael, Ph.D., Visiting Associate Professor of Zoology
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Shuman, R. Baird, Ph.D., Professor of Education
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Smith, David Alexander, Ph.D., Associate Professor of Mathematics
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Stark, John D., Ph.D., Visiting Associate Professor of History
Steegar, David M., M.A., Instructor of Romance Languages
Stern, Henry R., Ph.D., Associate Professor of German
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Sublett, Henry L., Jr., Ed.D., Associate Professor of Education
Sullivan, James B., Ph.D., Assistant Professor of Biochemistry
Sutherland, John P., Ph.D., Assistant Professor of Zoology
Swain, Myrtle T., Ed.D., Part-time Instructor in Education
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Tetel, Marcel, Ph.D., Professor of Romance Languages
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Wardroppe, Bruce W., Ph.D., William H. Wannomaker Professor of Romance Languages
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Weintraub, E. Roy, Ph.D., Associate Professor of Economics
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Weitz, Henry, Ed.D., Professor of Education
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Woalford, Ellen, B.A., Visiting Instructor of Anthropology
Yahe, William P., Ph.D., Professor of Economics



General Information

The Summer Program at Duke

The summer session at Duke University makes available to Duke students, to students from other universities and colleges, to teachers in elementary and secondary schools, and to other special students a notable program of instruction in many fields of knowledge, both academic and professional.

Course programs offered during the summer are designed to meet special and particular needs as well as the more conventional requirements leading to specific degrees.

Postdoctoral research scholars may find the regular summer session courses useful for further study. The library facilities and the various laboratories may be valuable for postdoctoral residents.

Graduate students who have been admitted to the Graduate School to study for the Master of Arts, Master of Education, and Master of Arts in Teaching degrees will find courses arranged in sequence from summer to summer to meet their requirements.

Teachers from elementary and secondary schools who desire to earn credits toward the renewal of their certificates and who are interested in further teacher training in subject content and method may enroll in senior-graduate courses as special or unclassified students.

Undergraduates of Duke University who desire to accelerate their programs may complete the work for a degree in three years by attending two or more summer sessions.

Undergraduates from other colleges and universities may enjoy the special advantages of summer instruction at Duke and transfer credits earned to their own institutions.

Although the summer course program meets, in many departments, the needs of degree candidates, it goes beyond these limits in also presenting courses of wide general interest and, in addition, special non-credit lectures, conferences, institutes, and workshops.

Duke University's ample and modern research facilities will be available during the summer to all properly qualified students. It is the hope of the University, of the summer faculty, and of the administrative officers that former students and new students will find increasing values in each summer spent at Duke.



2

Program Information

Undergraduate Study

Students in the undergraduate college and schools of Duke University who desire to enrich or accelerate their academic study will find summer programs to meet their individual needs and interests. Special courses are provided which are not otherwise available to undergraduates; election of the usual courses may relieve an overload during the fall or spring terms; and, summer programs also enable some students to attain provisional graduate status in the senior year or to graduate in less than four years.

By attending at least two terms of the summer session, it is possible for a student to earn credit for as many as 4 semester-courses. Instruction will be offered in the summer of 1974 in most departments and colleges. Specific requirements for degrees offered in the undergraduate colleges and schools may be obtained from the Bulletin of Undergraduate Instruction.

Divinity School Studies

Degrees of Master of Divinity and Master of Religious Education are administered by the faculty of the Divinity School. Students in these programs may register with the Summer Session Office for independent study in any one of the terms of the summer session or for the language courses which are listed under the heading Divinity School in this Bulletin. Persons desiring credit toward one of these degrees must be regularly admitted to the Divinity School and all courses taken by the student for Divinity School credit must be registered and approved by the Director of Academic Affairs of the Divinity School.

Graduate Study

Degrees and Requirements. The Graduate School of Duke University now offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.),



Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Hospital Administration (M.H.A.), Master of Business Administration (M.B.A.), Doctor of Philosophy (Ph.D.), and Doctor of Education (Ed.D.). Specific requirements relative to admission, residence, major and related studies, languages, and thesis requirements may be obtained from the Bulletin of the Graduate School.

Candidates for degrees in the Graduate School desiring to have their degrees conferred on September 1 must have completed all requirements for the degree as of the final day of the Duke University summer session. A candidate completing degree requirements after that date will have his degree officially conferred at the following May Graduation Exercises. (Transfer of credit for work completed at other universities must be recorded by September 15.)

Summer Program for Graduates. Summer sessions offer an excellent opportunity to advance or complete programs of graduate study already undertaken, to begin study toward a graduate degree at Duke University, to acquire graduate training useful in professional advancement, or to study for personal satisfaction. The several departments offer a variety of graduate courses, as listed in later pages, given by members of the Duke faculty and visiting professors.

Unclassified Graduate Students. Any student who holds an A.B. or B.S. degree and who does not intend to earn an advanced degree at Duke University but who desires graduate work for professional or other reasons should apply to the Director of the Summer Session for admission as an unclassified student. Credits earned by an unclassified graduate student in graduate courses taken at Duke before his admission to the Graduate School may be carried over into a graduate degree program if (1) the action is recommended by the student's director of graduate studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better. This policy shall be effective with students entering the Graduate School in September, 1971.

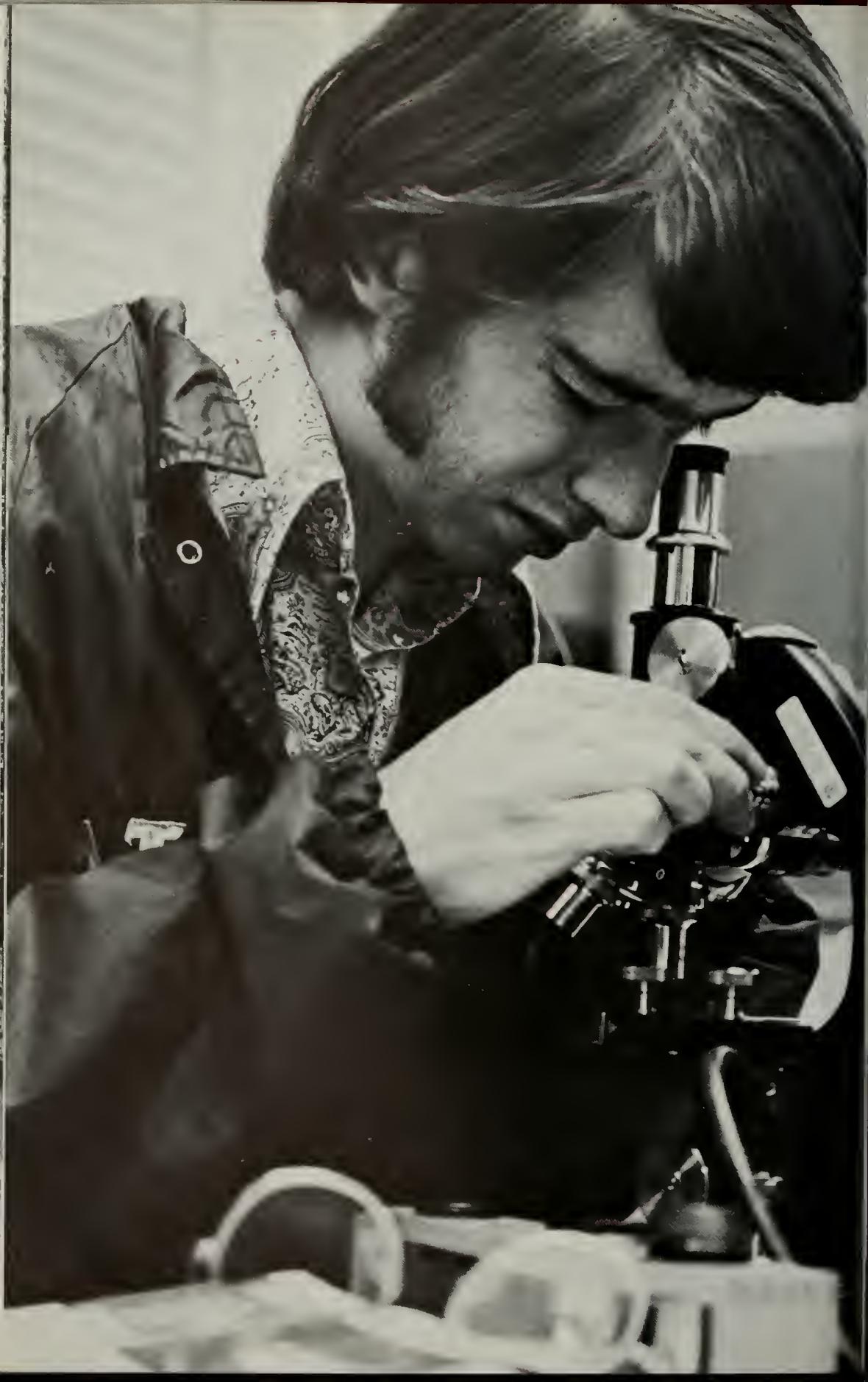
Cooperative Program in Teacher Education. Thirty-five to forty selected graduates of liberal arts colleges who desire to prepare for high school teaching will be admitted to a special internship program at Duke University. This program is designed to prepare for a teaching career selected college graduates who did not prepare professionally for teacher certification as undergraduates. The cooperative program provides, for candidates who are chosen, graduate study in their special fields, professional courses, and carefully supervised observation and teaching experiences. One who completes the program successfully can achieve, within a period of fifteen months, a year of teaching experience, a Master of Arts in Teaching degree, and full certification as a teacher.

Candidates will begin the program at the opening of Term II of the 1974 summer session and complete it in August 1975. They will spend two terms of the summer preceding and the summer following the year of teaching in residence at the University. During the school year 1974-1975 interns will be employed as regular teachers in cooperating public school systems. During this year they will receive full salary and will work under the joint supervision of the cooperating public school and the University. The program will meet training qualifications for the advanced or graduate teacher's certificate in many states. Participants in the program are expected to teach for a second year as fully certified teachers in the school in which they complete the internship.

The salary for the year of teaching will, in effect, constitute a substantial award to candidates selected for the program. Interns will benefit from Duke University's special tuition rate for teachers. Applicants will be considered, as are candidates for other awards, on a competitive basis. The best qualified applicants will be chosen on the basis of undergraduate record, recommendations, and evidence of interest in becoming high school teachers. Applicants are required to arrange interviews in connection with their applications. Application forms may be requested from the Dean of the Graduate School and should be submitted before February 15, 1974. Details concerning the program can be obtained by writing the Director, Cooperative Program in Teacher Education, Department of Education, Duke University.

Postdoctoral Research

Scholars engaged in postdoctoral research find it advantageous and sometimes essential to use the resources of the Duke University libraries during the summer. The University welcomes these visitors and makes living accommodations (dormitory space and dining facilities) available to them during the summer sessions from May 14 to August 17.



3

Special and Cooperative Programs

Cooperative Program

The long standing reciprocal agreement between Duke and the University of North Carolina is now effective for the summer sessions at both universities. To take advantage of this arrangement for either term of the summer session, the eligible student registers each term for 3 units of credit at the home institution and 3 units representing the course to be taken at the other institution, for a total of 6 units. A nominal registration fee of \$2 will be charged at the other institution. Credit so earned is not defined as transfer credit. This program applies to both graduate and undergraduate students.

Special Conferences and Courses

Special Programs for Teachers of Science and Mathematics. It is anticipated that the summer session will offer a number of special programs at the graduate level designed specifically for high school teachers of science and mathematics. For detailed information on the programs, teachers should write Dr. Sherwood Githens, Education Department, Duke University, Durham, North Carolina 27708.

Highlands Biological Station. Duke University holds a subscribing instructional membership in the Highlands Biological Station at Highlands, North Carolina, on the southern edge of the Blue Ridge Mountains at an elevation of 4,118 feet. The situation and the region offer an excellent opportunity for field studies and some laboratory work. A limited number of qualified students in botany and zoology may make arrangements to carry out research at this station.

Medical Mycology. A month's course in medical mycology, under the direction of Dr. Norman F. Conant, is to be offered through the Duke Medical

Center from July 1-27, 1974. The course will be offered every day in the week, except Sunday, and has been designed to ensure a working knowledge of the human pathogenic fungi within the time allotted.

Emphasis will be placed on the practical aspects of the laboratory as an aid in helping establish a diagnosis of fungus infection. Insofar as possible and as patients become available, methods of collecting materials in the clinic for study and culture will be stressed. Work with patients, clinical material, cultures, and laboratory animals will serve as a basis for this course. Also, an opportunity to study pathologic material, gross and microscopic, will be given to those students whose previous training would allow them to obtain the greatest benefit from a study of such material.

The enrollment for the course will be limited and the applications will be considered in the order in which they are received. An attempt will be made, however, to select students on the basis of their previous training and their stated need for this type of work.

A fee of \$200.00 will be charged for this course, upon the completion of which a certificate will be awarded. However, an applicant upon acceptance into the course may register with the Summer School, pay its fees instead of the fee stated above, and receive 4 units of graduate credit for the course. Please direct all inquiries to Dr. Norman F. Conant, Professor of Microbiology, Duke University Medical School, Durham, North Carolina 27710.

The Ministerial Course of Study School. In cooperation with the Board of Education and the Southeastern Jurisdictional Conference of the United Methodist Church, Professor Paul A. Mickey directs the Ministerial Course of Study School. This is not related to the regular Divinity School degree program and no credit toward a seminary degree can be earned. The twenty-sixth session of the school is from June 24 to July 19. For further information write the Director, Box 4484, Duke Station, Durham, North Carolina 27706.

Divinity School Summer Institute for Ministry. Seminars and clinics, running concurrently, for ministers, wives, and church leaders of all denominations will be conducted at the Duke Divinity School, July 1-5, 8-12, 1974. These are designed to supplement seminary education through one or two weeks of intensive training in academic and professional studies. No academic credit is given.

Sponsoring institutions make available funds for tuition. Other scholarships are available upon request. For full information write to: Director of Continuing Education, Duke Divinity School, Durham, North Carolina 27706.

Summer Theater Program. The new Summer Theater Program offers theater-oriented students and teachers an integral 4-course program of training in theater and dramatic literature during the first and second summer sessions.

A series of courses in play production and stagecraft will offer training by a professional actor-in-residence and technical director as well as the entire professional staff of Summer Theater at Duke, the University's highly successful summer stage. The courses will involve both formal instruction and supervised experience in all aspects of production from acting to scene design to publicity and management. In addition, a group of related courses in dramatic literature will offer the student a close study of great plays of the past and present.

The program will be of special interest to teachers who are involved in play production in their schools. The program does offer credit toward renewal of certification.



For information on courses in the Summer Theater Program, see English 120, 130, and 181S and Comparative Literature 151 and 160. Detailed information on faculty, courses, and programs of Summer Theater at Duke may be obtained by writing Box 4941 Duke Station, Durham, North Carolina 27706.

Southeastern Institute of Medieval and Renaissance Studies. The Southeastern Institute of Medieval and Renaissance Studies is established for the advancement of scholarship and improvement of teaching. Participation is open to those with scholarly interest in all areas of medieval and Renaissance studies, including (among others) art, aesthetics, history, literature, music, paleography, philosophy, and religion.

The Institute consists of six informal seminars, each concerned with a topic of interest to students of the medieval and Renaissance periods. Each seminar is led by a senior fellow and has an enrollment of about six participants, designated fellows. Each fellow participates in one seminar and has ample free time to devote to his own research. It is emphasized that the seminars are not courses but informal meetings to encourage the exchange of ideas and to stimulate participants in their own research. In most cases fellows will be beyond the Ph.D. level, but in some cases applications will be considered from advanced graduate students.

Annually the Institute alternates between the campuses of Duke University and the University of North Carolina at Chapel Hill. The sixth session, from July 15 to August 23, 1974, will be held on the Duke campus.



4

Resources for Study

Libraries

The William R. Perkins Library consists of the new research library building which was opened early in 1969 and the old building, which was renovated in 1970. The complex has about 2,100 seats, 700 of which are private carrels, and shelf space for 2,500,000 volumes.

On June 30, 1973, the University libraries, including nine school and six departmental collections, contained 2,438,962 volumes and more than 4,200,000 manuscripts. One hundred and ten thousand volumes were added during the year and about 15,000 periodicals are received regularly. Many rare and perishable materials which appeared in books, newspapers, periodicals, and manuscripts are available in microtext form and may be read in a special microtext reading room in the Perkins Library. Rare books and manuscripts have special quarters in the building, which are accessible to all members of the University community.

All libraries of the University are open for use throughout the summer. Guides to the Perkins Library for faculty and graduate and undergraduate students are available upon request to the University Librarian, Perkins Library, Duke University, Durham, North Carolina 27706.

Laboratories

The laboratories in the various science departments (Botany, Chemistry, Physics, Psychology, and Zoology) are designed for both teaching and research. Ideal locations for special work in some of the sciences are available at Duke University Marine Laboratory at Beaufort, North Carolina; at Highlands Biological Laboratory at Highlands, North Carolina; in the Duke Forest at Durham, North Carolina; and in the Sarah P. Duke Gardens on the West Campus of Duke University.



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5

Student Life

Living Accommodations

Housing. To provide maximum comfort and pleasant surroundings, the residence hall facilities in Few and Edens Quadrangles on West Campus are used to house most summer session students. Houses in Few Quadrangle are reserved for regularly enrolled undergraduate men and women. Graduate men and women may be assigned to Edens if necessary. Residence hall accommodations are not available for married couples or families.

For families and married couples, Duke University plans to have a number of one, two, and three-bedroom apartments available in the Central Campus Apartments by the summer of 1974. These apartments are located between East and West Campuses. Two-bedroom units are also available at Town House Apartments, located on Swift Avenue, and Duke-leased apartments (Duke Manor), located about three miles from the Chapel. For information regarding apartment accommodations, please write to the Manager of Apartments and Property, Department of Housing Management, Duke University, Durham, North Carolina 27706. Usually no apartment may be rented for less than four weeks; however, special arrangements may be made with the Department of Housing Management for periods of occupancy for less than one term. The facilities are air-conditioned.

Undergraduates, both men and women, are required to live in the residence halls unless they are married or living with parents or relatives or have received permission to reside off campus for the previous or subsequent academic year. Any exception must be approved in advance by the Dean of Students. The Director of Summer Session will advise the Dean of Students of all summer session undergraduate enrollments. The Dean of Students will advise the Department of Housing Management of the status of all students attending summer session who have been approved to reside off-campus.

The majority of residence hall rooms at Duke University are double

rooms, furnished for two persons. The limited number of single rooms are assigned in order of receipt of application with the required residential fees at the Department of Housing Management. No double room may be reserved for single occupancy.

Furnishings—Few and Edens Quadrangles. Each student will be provided with a glide-out bed, desk with chair, dresser, mirror, wastebasket, and adequate closet space. Each student should provide a desk lamp, bedspread, sheets, blanket, pillow and other items desired. Beds measure 80 in. by 30 in.

Furnishings—Town House Apartments and Duke-leased Apartments. Each attractive apartment is equipped for three persons and includes living room, kitchen, master bedroom (for two students), a single bedroom (one student), and a master bath with tub and shower. Housekeeping supplies, kitchenware, and linens must be provided by the occupants. The Town House Apartments have an additional half bath.

Furnishings—Central Campus Apartments. Information will be provided upon request to the Manager of Apartments and Property, Duke University, Durham, North Carolina 27706.

Dining Service. Food service is cafeteria style. The cost of meals runs from \$2.50 to \$3.00 per day, depending on the needs and tastes of the individual. Only the dining facilities on the West Campus will be used for the regular summer session students. The cafeteria in the Men's Graduate Center is usually not open in the summer.

Duke University Marine Laboratory. The Duke University Marine Laboratory, located on Pivers Islands, has cottage-type residence halls which will be available for summer session students. Further information may be obtained from the Bulletin of the Duke University Marine Laboratory.

Services Available

Medical Care. The Student Health Service, in the Marshall I. Pickens Rehabilitation Center, operates during the summer session and offers exactly the same medical and surgical services available to each full-time student during the academic year, as described completely in the Bulletin of Information and Regulations except for hospitalization in the University Infirmary. The Infirmary facilities are closed during the summer sessions.

The Student Mental Health Service is located in the Pickens Rehabilitation Building on Erwin Road. The interest of the Student Mental Health Service is the emotional well-being of the Duke student body. The service provides evaluation and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Student Mental Health Service records are maintained separately and are not a part of any other record system, academic or medical. Contact with the service is strictly confidential.

No illness is treated in the dormitory or other rooms occupied by students.

A student must present the 1974 summer session student identification card as evidence that he is matriculated in the summer session and entitled to care at the Student Health Service in the Marshall I. Pickens Rehabilitation Building.

Regular Clinic services are available for use from 8 a.m. to 8 p.m. Monday through Saturday and from 2 p.m. to 8 p.m. Sunday at the University Health Clinic, Pickens Building, West Campus, Duke extension 7621.



For emergency problems (when the University Health Clinic is not open), the emergency room at Duke Hospital (Duke Extension 2413) is available. The financial responsibility for expenses incurred in the Emergency Room rests with the student and his parents, though it is anticipated that most, if not all, such services will be covered under the Duke Student Accident and Sickness Insurance Policy or the student's personal accident and sickness insurance policy. This Duke Student Accident and Sickness Insurance Policy will cover only true emergencies necessitating treatment at the Hospital Emergency Room. The Emergency Room Business Office will assist in filing claims under this and other health insurance policies.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for any and all services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The Student Health Program does not provide health care for spouses and dependent children of married students. There are provisions in the Insurance Plan, however, for coverage of the married student's family. Pre-existing conditions of dependent spouse and/or children are not covered.

The University expects all students to be financially responsible for medical expenses beyond those covered by the University Student Health program through supplemental accident and sickness insurance policies or their own personal financial resources.

These rules and regulations are those in effect at the time of publication of this document, but are subject to change at a later date.

The University Counseling Center. The University maintains a University Counseling Center which provides a centralized program of educational, vocational, and personal counseling for students. This confidential counseling service on problems of personal, social, educational, and vocational adjustment is provided without cost to students enrolled at the University. In addition, the center administers special group testing programs for University schools and departments and serves as the local testing center for a wide variety of national testing programs. The center also carries on programs of research in the field of measurement and counseling. Although the counseling, testing, and research services of the center are designed primarily to meet the needs of the students, faculty, and staff of Duke University, these services are made available to individuals and organizations outside the University as its facilities permit. Requests for further information should be addressed to the Director, University Counseling Center, 309 Flowers, Duke University, Durham, North Carolina 27706.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are



offered without charge to students in the summer session who are registered for a degree at Duke University. The staff is available to talk with summer session students about their professional plans and with school officials who may be seeking the services of new teachers. Students who are eligible to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations should be accumulated during the time a student is enrolled at Duke. Copies of academic records are released only with the permission of the individual.

Student Activities

Religious Life. The Duke Chapel and its related ministry offer to participants in the summer sessions opportunities for worship, study, and service. The Sunday morning worship at 11:00 a.m. in the Chapel is the central focus for this ministry.

Recreation and Activities. The summer session will provide a varied program of entertainment and recreation. The program includes movies, dances, and open house socials. Tours to areas of interest can be arranged for weekends. Both the mountains and the seashore are easily accessible. Adequate facilities are available for those interested in swimming, tennis, and other sports. Clubs organized for the summer play an active part in all social activities and recreation.

Publications

During the summer session the University will publish each Saturday *The Duke University Colendor*, an official calendar announcing events—academic, social, and recreational—of the following week. This calendar also includes official notices concerning academic requirements. Students are expected therefore to read the *Colendar* regularly.

Conduct of Students

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as currently in effect or, from time to time, are put into effect by the appropriate authorities of the University. The student is expected to be familiar with the current *Bulletin of Information ond Regulotions* as well as any published regulations for the summer session.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University. University authorities will take action in accordance with academic due process.



6

Admission

Qualifications for Admission

Students in the following categories may be admitted to the Duke University Summer Session:

1. Graduates and undergraduates who are presently enrolled and in good standing in Duke University.
2. Graduates and undergraduates who have been formally admitted or readmitted to Duke University.
3. Students who are currently in good standing at their respective institution and who have approval by the proper authority to take and transfer credits earned in the Duke Summer Session.
4. Teachers in service with or without the bachelor's degree who wish to earn credits for certification purposes.

Admission to specific courses offered in the summer session is governed by the student's academic status (freshman, sophomore, junior, senior, graduate, special, or unclassified) and by the prerequisites of the course in question. All applicants will be considered without regard to race, color, religion, sex, or national origin.

Application Procedures

Duke Students in Residence during the Spring Semester, 1974. A Duke University student either graduate or undergraduate, who plans to attend the summer session should at the time of preregistration for the fall semester (see page 30-32 for specific dates) enroll for the desired summer session courses. He need not file with the Summer Session Office the application blank at the end of this Bulletin.



Undergraduates Not in Residence at Duke during the Spring Semester, 1974. New students seeking to enter Duke University as freshmen or as undergraduates with advanced standing, and undergraduates who wish to re-enter the University, should write the Office of Admissions requesting application forms.

Undergraduates, both men and women, enrolled in other colleges and universities who desire to earn in the Duke University Summer Session credits which are to be transferred to their own institutions should apply directly to the Director of the Summer Session, Duke University, on the application form at the end of this Bulletin. They should give accurately and clearly all information called for on the application form.

Graduates Not in Residence at Duke during the Spring Semester, 1974. Students who are seeking admission to the Graduate School and those who

have been admitted to the Graduate School must apply to the Director of the Summer Session on the application form at the end of this Bulletin. Those who are seeking admission to the Graduate School must also file Graduate School application forms which may be secured by writing to the Dean of the Graduate School, Duke University, Durham, North Carolina 27706.

Students with graduate standing and currently employed as teachers who wish only to earn credits toward renewal or the advancement of their certificate may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. Credits earned by unclassified graduate students in graduate courses at Duke may later be counted toward an advanced degree at Duke if the conditions stated on page 5 are met. All students in the unclassified category should apply to the Director of the Summer Session for admission. The application at the end of this Bulletin may be used.

Postdoctoral Scholars. Application for these postdoctoral research privileges must be made in advance by letter to the Director of the Summer Session giving the applicant's present position, the specific field of his research interest, and the dates during which he desires to be in residence. Approved applicants will be accepted subject to the availability of library and dormitory space.

Admission to Degree Candidacy

Undergraduates. A student seeking to enroll as a candidate for the bachelor's degree from a college or school of Duke University must meet the entrance requirements set forth in the Bulletin of Undergraduate Instruction and be accepted by the Director of Admissions, Duke University. This Bulletin may be secured by writing the Office of Admissions, Duke University.

Graduates. A student seeking to enroll as a candidate for one of the advanced degrees offered by the Graduate School of Duke University must meet the requirements set forth in the Bulletin of the Graduate School. This Bulletin may be secured by writing to the Office of the Graduate School, Duke University.





Financial Information

Tuition and Fees

The University Tuition. The following charges will cover registration and medical care:

1. Tuition for undergraduates—\$207.00 for each non-laboratory course, \$276.00 for each undergraduate laboratory course, and \$414.00 for each one and one-half course program offered at the Marine Laboratory.
2. Tuition for graduate students—\$69.00 per unit; for an undergraduate course, the tuition rate as indicated in paragraph 1 above.
3. Teachers in full-time service in elementary and secondary schools, except teachers pursuing a doctoral program at Duke—one-half of the tuition charges specified in paragraphs 1 and 2 above.
4. All students pursuing a doctoral program (post-master's) at Duke—fees as specified in paragraphs 1 and 2.
5. Divinity School students approved by the Dean of that school—one-half of the tuition charge specified in paragraph 1 and 2 above, when the course is a requirement for the student's program.

Laboratory Fees. For Marine Laboratory investigators' research table fee, see the *Marine Laboratory Bulletin*.

Medical Mycology Fee. This fee of \$200.00 replaces the University tuition.

Master's Degree Summer Session Tuition. A master's candidate who submits his thesis when not registered for at least 1 unit of research-residence tuition is required to pay the 1-unit tuition of \$69.00.

Auditing Fees. These fees are as follows:

1. Students registered for a full course program may audit non-laboratory courses (with the permission of the Director) at no extra charge.
2. Students carrying less than a full course program may be granted permission to audit a course but they will pay half the University fee for the course.



Late Registration Fee. Students who fail to register prior to the first class day of a given course will pay an extra fee of \$10.00.

Fee for Course Changes. Course changes other than those required by the University will be made only on payment of an extra fee of \$1.00 per change.

Fee for Make-up Final Examination. This fee is \$5.00.

Refund for Tuition and Fees. Tuition and fees will be refunded under the following circumstances:

1. When applications for withdrawal are received by the Director of the Summer Session before the first class day of a given term of the Summer Session, full tuition and fees will be refunded.
2. When applications for withdrawal are received by the Director of the Summer Session during the first four class days of a given term, 80 percent of the tuition and fees will be refunded.
3. When applications for withdrawal are received by the Director of the Summer Session after the fourth class day, there will be no refund of tuition and fees.

Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

Living Accommodations

UNDERGRADUATE AND GRADUATE RESIDENCE HALLS

Few and Edens Quadrangles

Single Room

\$117.50 per term

\$100.00 per term for undergraduate courses in chemistry and physics; also medical mycology

Double Room

\$87.50 per term

\$72.00 per term for undergraduate chemistry and physics; also medical mycology

On request rates will be quoted for periods less than one term.

TOWN HOUSE APARTMENTS (GRADUATE STUDENTS) DUKE LEASED APARTMENTS (ALL STUDENTS)

\$110.00 per summer session term (three to an apartment)

\$165.00 per summer session term (two to an apartment)

Air-conditioned. On request special rates will be quoted for families and for periods less than one term. A \$50.00 residential deposit is required of all persons occupying apartments.

CENTRAL CAMPUS APARTMENTS

At the time of publication of this Bulletin, fees had not been established for Central Campus Apartments. Information will be provided upon request to the Manager of Apartments and Property, Duke University, Durham, North Carolina 27706.

Housing Procedures. Application for room or apartment reservations at Duke University, accompanied by the full amount of the room rent for the application period, should be made to the Department of Housing Management, Duke University, Duke Station, Durham, North Carolina 27706. Rooms and spaces in apartments will be reserved in the order in which applications with full payment of fees (residential deposit of \$50 is necessary for spaces in apartments) are received and on certification of admission by the Director of the Summer Session. Notification of assignment to rooms or apartments will be made about April 20 for the first term, about May 30 for the second term, and about July 1 for the third term.

Rooms and apartments are available to applicants at noon on the day before the first day of classes for each summer term. A room or apartment must be vacated by the occupant before 5 p.m. on the last day of the final examination period for each session or on the final day of the agreement period, as appropriate. Any period of occupancy, other than a term must be arranged with the Department of Housing Management, House D, Room 101-R, Duke University.

Refund of Housing Fees. Refunds are made under the following circumstances:

1. When notification for a housing cancellation is received by the Department of Housing Management on or before ten (10) days prior to the first day of scheduled classes of the summer session term, full housing fees will be refunded, provided space has not been occupied.
2. When a student withdraws from a summer session term and cancels a housing assignment during the first five (5) days of classes, refund will be made for the total amount paid for the term, less \$28.00 (single room) or \$21.00 (double room) in the case of residence hall cancellation, and \$22.00 (three to an apartment) or \$33.00 (two to an apartment) in the case of cancellation of Town House and Duke Manor Apartments.
3. When a student withdraws from a summer session term and cancels a housing assignment between the fifth day and the tenth day of classes, refund will be made for the total amount paid for the term, less \$54.00 (single room) or \$40.00 (double room) in the case of a residence hall cancellation, and \$44.00 (three to an apartment) or \$66.00 (two to an apartment) in the case of cancellation for Town House or Duke Manor Apartments.

4. If a request for a cancellation of a housing assignment for a summer session term is made (for reasons other than withdrawal from summer session) on or after the eleventh day of classes, no refund will be made.
5. If a student withdraws from a summer session term after the eleventh day of classes, 50 percent of the unused portion of the housing fee will be refunded.

If a preference of a roommate is desired, this information should be shown on the application form. If no preference of a roommate is expressed, the Department of Housing Management will assign a roommate.

Requests for housing at the Duke Marine Laboratory, Beaufort, North Carolina, should be addressed to the Business Manager, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Estimated Cost of One Term of the Summer Session

University tuition, two non-laboratory courses or 6 graduate units	\$414.00*
Residence Hall Fees (double room for one term)	\$ 87.50
Meals (cafeteria selective; average per day \$2.50)	\$ 90.00†
Books and class materials (average)	\$ 18.50†
Miscellaneous (laundry, etc.)	\$ 19.00†
Total	\$629.00

Student Aid

Special Tuition Rate to Teachers. Teachers in full-time service in elementary and secondary schools, except those who are pursuing a doctoral program at Duke, pay only one-half of the regular tuition charge. Teachers on leave of absence from their schools and teachers not currently employed are not eligible for this special fee.

Scholarships for Public School Personnel. Duke University will offer 25 special scholarships of \$210.00 each to high school and elementary teachers on a competitive basis (not by a written examination) for the summer session of 1974. This scholarship program is designed to encourage teachers to begin or to continue their graduate studies leading to the A.M., M.Ed., or M.A.T. degree.

Duke University will again offer five special scholarships of \$225.00 each to high school and elementary administrators and supervisors. This scholarship program is designed to encourage principals and supervisors to continue their graduate studies leading to advanced degrees.

Although successful applicants for the scholarships will not be required to become candidates for a degree, they must qualify for and receive admission to the Graduate School.

All applications with supporting documents must be submitted by April 1, 1974. Selection and appointment of scholars will be completed by May 1, 1974.

* Teachers, elementary and secondary, in full-time service (except teachers pursuing a doctoral program at Duke) pay \$207.00.

† Approximate costs which will vary according to individual tastes and needs.

Application blanks and complete information may be obtained from the Director of the Summer Session, Duke University, Durham, North Carolina 27706.

Loans. A number of loan funds have been established for the benefit of the students of Duke University. Several of these funds are available to students enrolled in the summer session. Students enrolled in the summer session only are not eligible. These funds are administered through a committee of officers of the University.

The committee, in approving loans, selects those students who, from the standpoint of character, scholastic attainment, and degree of financial need, are deserving of consideration.

Applicants for loans should make application to the Manager, Student Loan Office, Duke University. All applications must be initiated during the first week of each term. The granting or withholding of a loan is a matter entirely within the discretion of the Student Loan Committee. A student is expected to use all other possible means of securing financial assistance before applying for aid from a loan fund.

National Direct Student Loon Progrom. A limited number of loans may be made, under the provisions of the Education Amendments of 1972, to students in the summer session who have been regularly enrolled in the University prior to the summer session. A student who is enrolled for study in the summer session only is not eligible for consideration. Students pursuing the M.A.T. Cooperative Program are not eligible. Inquiries concerning opportunities available under this program should be made to the Manager, Student Loan Office, Duke University, Durham, North Carolina 27706.

Duke University Federolly Insured Loon Program. Under this program, students are allowed to borrow up to \$2,500.00 per year at 7% interest rate. An interest subsidy is available from federal funds for all students who have demonstrated need on the Parents' Confidential Statement. As under the National Direct Student Loan Program, loans can be made to students in the summer session who have been regularly enrolled in the University prior to the summer session. A student who is enrolled for study in the summer session only is not eligible for consideration. Inquiries concerning opportunities available under this program should be made to the Manager, Student Loan Office, Duke University, Durham, North Carolina 27706.

Remission of Tuition. Children of Methodist ministers who are members of the North Carolina and Western North Carolina Conferences of the United Methodist Church are entitled to a remission of the tuition charge as are the children of fulltime ministers of all faiths serving churches in Durham County, North Carolina. This consideration is given only to the children of resident members of the two North Carolina conferences who are giving their full time to religious work. Only those students enrolled in a regular undergraduate program leading to a baccalaureate degree from the University are entitled to this benefit. Students in this group are entitled to a maximum of eight semesters of free tuition at the undergraduate level. Application for this benefit should be made to the Director of Undergraduate Financial Aid, Duke University, Durham, North Carolina 27706.

Tuition Grants. Tuition grants are available to children of faculty and qualified staff members of Duke University. Information regarding the tuition grant program may be obtained by writing to the Director of Undergraduate Financial Aid, Duke University.



8

Registration and Regulations

Definition of Terms

Registration. A student has completed registration for the summer session when:

1. His course program has been written and approved by the dean of the school or college in which he is enrolled or by the Director of the Summer Session in the case of the special or unclassified student.
2. Summer session forms have been completed properly by the student in the Summer Session Office.
3. Summer session University fees have been paid. A place in a course cannot be assured until fees have been paid. Tuition bills are not sent to the student's home.

Pre-enrollment. The term *pre-enrollment* refers only to the writing of the course program and its approval by the proper authority or by the Director of the Summer Session in the case of the special or unclassified student. Pre-enrollment alone does not constitute registration.

General Registration

In the 1974 summer session, classes in Term I will begin on Tuesday, May 14; in Term II on Monday, June 17; and, in Term III on Thursday, July 18. A student attending Term I or Term II of the 1974 summer session must complete his registration in the Summer Session Office, 116 Allen, on or before the Friday preceding the first class day of the given term: Term I, Friday, May 10, Term II, Friday, June 14. Students attending Term III must complete their registration in the Summer Session Office on or before Wednesday, July 17.

A student in classes beginning on dates other than the beginning date

of each of the three terms must complete his registration in the Summer Session Office before the date on which those classes begin.

Late Registration

Any student who fails to register on or before the dates specified in the preceding paragraphs will be charged a fee of \$10 for the late registration. All late registrations and course changes must be completed by the end of the third class day of each term (May 16, Term I; June 19, Term II; and July 22, Term III). All course changes must be approved by the dean of the school or college in which the student is enrolled, or, in the case of the special or unclassified student, by the Director of the Summer Session.

Since summer session courses present a program of study in more concentrated and rapid form than in the regular semesters, students are advised to register on time and to be present at all class sessions.

Advanced Registration

Students in Residence during the Spring Semester, 1974. Graduate and undergraduate students in residence at Duke University during the spring semester, 1974, who plan to enroll for courses or research in one or more terms of the 1974 summer session will write course programs and have them approved in their respective schools or college during the week of preregistration, April 2-5, 1974.

Graduate and undergraduate students in residence, whose course programs have been written and approved by their respective schools or college on the date indicated above, may complete their registration in the Summer Session Office, 116 Allen Building, by paying their tuition from May 1-10.

A Duke student, graduate or undergraduate, who desires to attend the summer session but did not preregister on April 2-5 should complete his registration by the Friday preceding the beginning of the term he wishes to attend.

Students Not in Residence at Duke during the Spring Semester, 1974. Students not in residence at Duke University during the spring semester, 1974—new undergraduate students seeking to enter as degree candidates, graduate students who are not candidates for an advanced degree at Duke University, graduate and undergraduate students of other colleges and universities desiring to earn credits for transfer, public school teachers, and college teachers (not advanced degree candidates)—may register by mail. Advance registration by mail includes:

1. Completion in full of the application form at the end of this Bulletin.
2. Admission to the summer session by the Director of the Summer Session and, in the case of a student seeking to enter Duke University as a degree candidate, admission by the admissions director to the school or college of Duke University concerned.
3. Completion in full and return of forms required by the Summer Session Office at least one week prior to the beginning of the term involved.
4. Payment of tuition by at least one week prior to the beginning of classes.

Students who have not completed their registration by mail for courses in Terms I and II should complete their registration in the Summer Session



Office, 116 Allen Building, on the Friday previous to the first class day in Terms I and II. For Term III, the student must complete his registration in the Summer Session Office on Wednesday, July 17.

Degree-Candidate Graduate Students Not in Residence during the Spring Semester, 1974. A graduate student not in residence during the spring semester, 1974, who is a candidate for an advanced degree in the Graduate School of Duke University, may complete his registration by mail if his director of graduate studies and the Graduate School Office approve the registration. The student will follow the same four steps given above. Any graduate student unable to complete registration by mail must present himself for registration in the Summer Session Office on May 10 for Term I, June 14 for Term II, and July 17 for Term III.

Registration of Graduate Students. Graduate students in residence during the spring semester will preregister for one or more terms of the summer session on April 2-5. Newly admitted graduate students who have not completed their registration by mail should present themselves for registration at the official registration periods. All graduate students are required to register both with the Summer Session Office and with the Graduate School Office.

Graduate students resident in the spring semester who intend to remain in residence during one or more of the three summer session terms without registering for course work or at least 1 unit of research must register for 1 unit to cover the cost of medical care and the use of University facilities. These units of registration will entitle students to use the Student Health Service and University's facilities during the three terms of the summer session. The master's candidate who has completed all require-

ments except submission of the thesis and who so registers is not charged any separate fee for submitting the thesis, but he is required to register for 1 unit.

Graduates Not in Residence at Duke during the Spring Semester, 1974.

Students who are seeking admission to the Graduate School and those who have been admitted to the Graduate School must apply to the Director of the Summer Session on the application form at the end of this Bulletin. Those who are seeking admission to the Graduate School must also file Graduate School application forms which may be secured by writing to the Dean of Graduate School, Duke University, Durham, North Carolina 27706.

Students with graduate standing and currently employed as teachers who only wish to earn credits toward renewal or the advancement of their certificate may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. Credits earned by unclassified graduate students in graduate courses at Duke may later be counted toward an advanced degree at Duke if the conditions stated on page 5 are met. All students in the unclassified category should apply to the Director of the Summer Session for admission. The application form at the end of this Bulletin may be used.

Academic Regulations

Types of Course Enrollment. Summer session courses may be taken for credit or may be audited. A student's program may be exclusively in one of these categories, or may combine the two of them. Students taking a full or partial program for credit may enroll as auditors in any number of additional courses.

The summer session term credit does not mean degree credit at Duke University unless the student has been admitted as a degree candidate by one of the colleges or schools of the University. A student taking a course for credit is expected to do all the work required and to take the final examination, and he will receive a grade. G.I. Bill benefits are available only to those veterans who enroll for credit.

An auditor is entitled to listen to lectures and class discussions, but he may not participate in discussions or take examinations. A student carrying a full program for credit may be given permission to audit as many courses as he desires without additional fees. Students carrying less than a full program for credit may secure permission to audit but are required to pay the auditing fee, which is half the regular fee.

Credits. The summer session courses are of the same quality and credit values as courses in the regular semester. Credit earned in the summer session is in terms of courses or units. The majority of summer session courses carry one course to 3 graduate units of credit and require one term in residence.

A student desiring either graduate or undergraduate credits transferred from Duke University to his university or college as degree credit must request from the Director of the Summer Session, Duke University, a Course Approval Form to be completed by the student's dean or registrar and returned to the Director of the Summer Session.

Under certain circumstances a maximum credit of 6 units in a master's degree program may be allowed for graduate courses completed elsewhere. Approval for the transfer of credits will not be given until the student has

spent one semester or two terms in residence. The acceptance of credit up to this amount will not reduce the minimum period of full-time registered residence at Duke University. In no case will credit be allowed for extension or correspondence courses.

With the approval of both the student's major department and the Dean of the Graduate School, a student who is granted such transfer for credit may be permitted to register for as much as 12 units for thesis research instead of the usual 6 units. Or he may be permitted to fill out his schedule with as much as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level.

For regulations concerning the application of graduate credit earned elsewhere to a graduate program here, consult the Bulletin of the Graduate School.

See page 7 for information concerning reciprocal agreement with the University of North Carolina.

Professional credits toward teacher's certificates are granted by the various state boards of education, each in accordance with its own carefully planned rules. Teachers in service, before enrolling for certification credit, should consult the rules laid down by their State Board of Education. If necessary, they should send to their State Board of Education a list of the courses in which they plan to enroll and inquire whether these will be acceptable for certification credit.

Maximum Course Program. The maximum program for one term of the summer session is two courses.

Dropping of Courses. During the first three days of classes in any term, a student may add or drop a course with the permission of the instructor. Thereafter, no course may be added. A course may be dropped without penalty, however, until the end of the second week of each term with the permission of an academic dean. (The permission of the Director of the Summer Session is required for students from other universities or colleges.) Courses dropped after the second week are ordinarily assigned an F grade, as are courses dropped without permission.

Grading. Only a student taking a course for credit will receive a grade. The grade given represents the quality of the work done in the course.

Passed. The following are passing grades for undergraduates and graduates:

Undergraduate Grades

A—exceptional
B—superior
C—satisfactory
D—low pass

Graduate Grades

E—exceptional
G—good
S—satisfactory

Failed. A grade of F indicates that the student has failed the course. In order to receive credit for the course he must repeat the work in class.

Pass/fail Option. With the consent of the instructor and faculty adviser, a student who has declared a major may choose to be graded on a pass/fail basis in one elective, non-major course each summer. In addition, with the consent of the instructor, adviser, and director of undergraduate studies a student may take for pass/fail credit courses in independent study or internship in any department including that of his major. Certain internships and small group experiences will be offered only on a pass/fail basis.

A student enrolling in a course on a pass/fail basis completes all the work of the course but receives either a pass (P) or fail (U) grade in lieu of a standard grade. After the first three days of classes in any term, no student may change his status to or from a pass/fail basis. A pass grade may not subsequently be converted to a regular letter grade nor may the course be retaken on a regular credit basis.

For the effect of the election of the pass/fail option in determining honors, consult the Bulletin of Undergraduate Instruction.

Incomplete. A grade of I may be reported by the instructor if for any reason he is unable to report the final grade at the regular time. Incomplete courses must be completed before the close of the succeeding semester; otherwise the I is recorded as F, and the course must be repeated in class if the student is to receive credit for it.

Absent from Final Examination. The grade of X indicates that the student was absent from the regularly scheduled examination. A student absent from examination, if the absence has been excused by the dean of the college or school in which he is enrolled or, in the case of the special or unclassified student, by the Director of the Summer Session, may receive an examination upon the payment of \$5 to the Bursar of the University. The instructor concerned arranges for the examination in cases where absences are excused. A student with an X grade who has not obtained a passing grade before the end of the semester following that in which the X was incurred is regarded as having failed in the course concerned and must repeat the work in class in order to receive credit. If a student's absence from an examination is not excused by the dean of the college or school in which he is enrolled or, in the case of the special or unclassified student, by the Director of the Summer Session, his grade for the course concerned is recorded as F.

Examinations. Final examinations in courses are held on the last two days of each term. Final examinations for short courses will be held on the last day of the course. The examination dates for the first term are June 14-15, second term July 16-17, and third term August 16-17.

Courses in science for the first term have been scheduled so that their final examination will come on June 15. The science courses which begin on June 17 and run for four weeks will have their final examination on July 12. The University has no provision for giving examinations in absentia. Students absent from examinations for valid reasons are permitted a liberal extension of time to return to the University for the completion of credit.

Continuation Requirements. A student must achieve a satisfactory record of performance during the summer session in order to maintain his enrollment at Duke. Students regularly enrolled in Trinity College of Arts and Sciences who fail more than one course in a summer term or in a summer session will be excluded from the College. Where continuation from the summer session into the fall semester is in question, incomplete work in any course is considered failure to achieve a satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the Registrar no later than the day preceding the first day of classes for the fall semester. No student who has incomplete course work from both the spring semester and the summer session may continue into the fall semester.

A student from another university or college may be dismissed by the Director of the Summer Session for failure to exhibit satisfactory performance.



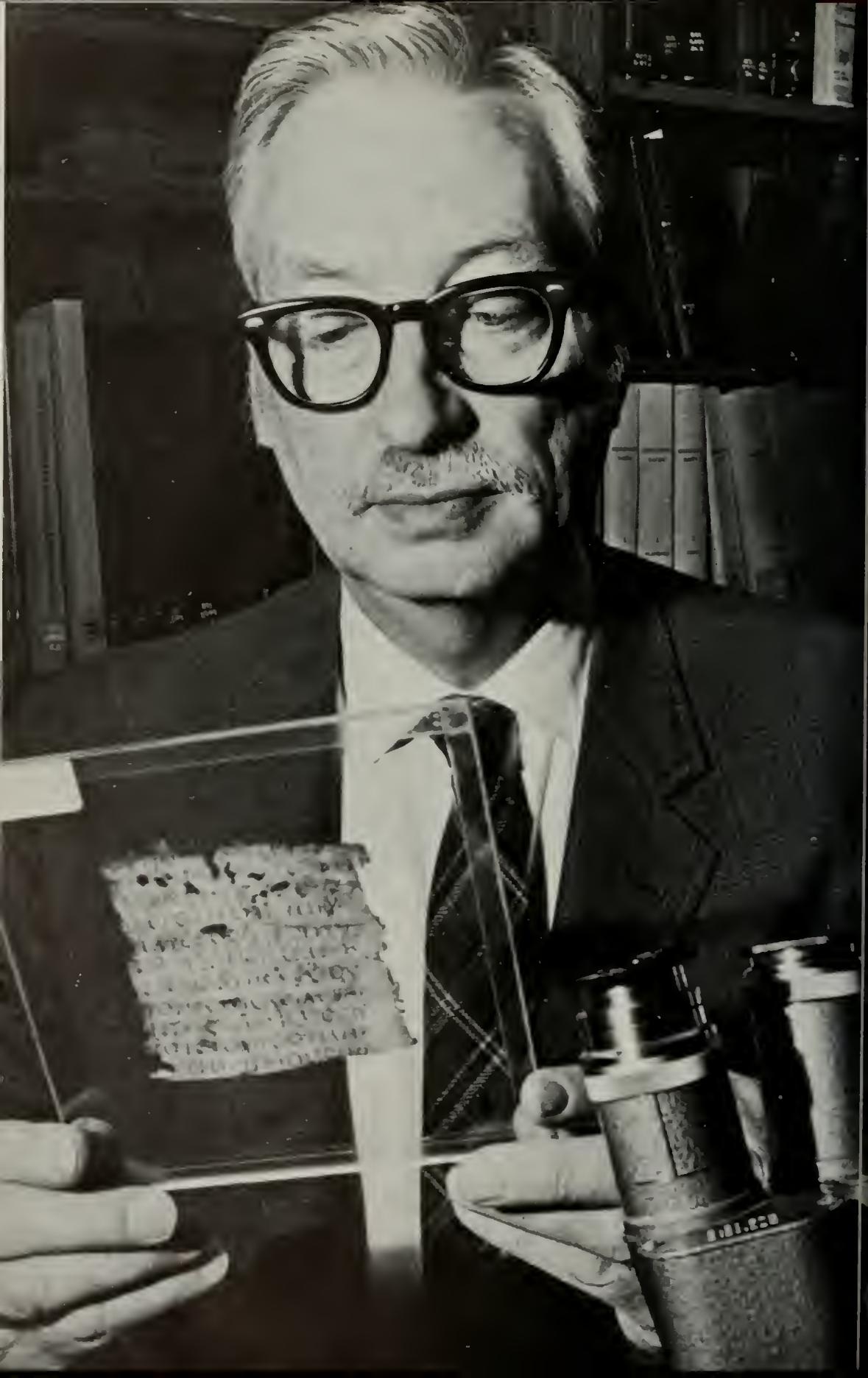
Withdrawal from the Summer Session. If a student wishes to withdraw from the summer session, he must notify both the dean of the school or college in which he is registered and the Director of the Summer Session.

Motor Vehicle Regulation

Students enrolled in the summer session must register their motor vehicles with the Traffic Office, 2010 Campus Drive, West Campus.

To register a vehicle, the student must present the following documents: (1) state vehicle registration certificate; (2) valid driver's license; and (3) satisfactory evidence of automobile liability insurance as required by North Carolina law—\$10,000 per person, \$20,000 per accident for personal injuries, and \$5,000 property damage. A small parking fee will be charged.

Parking, traffic, and safety regulations will be given each student who registers his vehicle. Students are expected to abide by these regulations.



Courses of Instruction

Course Enrollment

Eligibility. Courses numbered 1-49 are primarily for freshmen, or freshmen and sophomores. Courses numbered 50-99 are ordinarily for sophomores, or sophomores and juniors. Courses numbered 100-199 are designed for juniors and seniors. Courses numbered 200-299 are planned for seniors and graduates. Courses numbered 300 up admit graduate students only. Courses numbered from 200 up are limited in enrollment to 25 students.

Minimum Enrollment Required. All courses are offered subject to minimum enrollments. The University reserves the right to withdraw undergraduate courses in which fewer than twelve students enroll, senior-graduate courses numbered 200-299 in which fewer than ten students enroll, and graduate courses and seminars numbered 300 or above in which fewer than six students enroll. In withdrawing a course, the University attempts to avoid undue hardships on students. Sometimes, therefore, courses are offered in spite of small enrollments. Courses not listed will be given when a demand develops and an instructor is available.

Departmental Officials and Regulations

Departments offering summer session programs are listed alphabetically. Under each department is given the name of the chairman, of the director of graduate studies, and of the director of undergraduate studies. Where departments have set up special regulations for admission to candidacy for the master's degree, these are included.

Summer Session Schedule of Classes

Summer session classes will meet Monday through Friday each week, except classes will be held on Saturday, May 18 and Saturday, June 15 during

Term I; and on Saturday, August 17 during Term III. The other Saturdays during each term are available for conferences or class work.

Class periods are as follows:

Term I:

First period:	8:00 a.m. to 9:20 a.m.
Second period:	9:40 a.m. to 11:00 a.m.
Third period:	11:20 a.m. to 12:40 p.m.
Fourth period:	1:20 p.m. to 2:40 p.m.

Terms II and III:

First period:	8:00 a.m. to 9:30 a.m.
Second period:	9:45 a.m. to 11:15 a.m.
Third period:	11:30 a.m. to 1:00 p.m.
Fourth period:	1:30 p.m. to 3:00 p.m.

The meeting place for a course is indicated immediately after the class period for the course. Building designations are as follows:

East Campus

A—West Duke	5—Foreign Languages
B—Carr	9—Psychology-Sociology
C—Science	10—Social Sciences
F—Bivins	49—Physics

West Campus

3—Gray	58—Biological Sciences
4—Perkins Library	65—Gross Chemistry

CG—Card Gym

Anatomy

Professor Robertson, Chairman (401 Davison, West Campus); Assistant Professor Adelman, Director of Graduate Studies (270 Sands Building, West Campus)

First Term

312. Research. Individual investigations in the various fields of anatomy. (Consult Graduate School Bulletin for description.) Credits to be arranged. Permission of staff required. Stoff

340. Tutorial in Advanced Anatomy. (Consult Graduate School Bulletin for description.) Stoff.

354. Research Techniques in Anatomy. (Consult Graduate School Bulletin for description.) Stoff.

Second Term

208. Anatomy of the Trunk. Designed for Ph.D. degree candidates in anatomy as well as practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisites: core course in anatomy and permission of instructor. Number of students arranged by staff. 2 units. Duke.

312. Research. Individual investigations in the various fields of anatomy.

(Consult Graduate School Bulletin for description.) Credits to be arranged. Permission of staff required. Staff.

Third Term

312. Research. Individual investigations in the various fields of anatomy. (Consult Graduate School Bulletin for description.) Credits to be arranged. Permission of staff required. Staff.

Anthropology

Professor Friedl, Chairman and Director of Graduate Studies (346 Sociology-Psychology Building); Associate Professor Fox, Director of Undergraduate Studies (344 Sociology-Psychology Building)

First Term

93. Human Origins. Origins and distributions of mankind; primate evolution; a survey of human paleontology and human biology, prehistory and language; and the origins of human social organization and culture. One course. Beecher. 11:20-12:40. 9.126

94. Cultural Anthropology. A study of the dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. One course. Woolford. 9:40-11:00. 9.126

Second Term

93. Human Origins. Origins and distributions of mankind; primate evolution; a survey of human paleontology and human biology, prehistory and language; and the origins of human social organization and culture. One course. Beecher. 9:45-11:15. 9.127

119. Language, Culture, and Society. Analysis of language behavior within and across societies relating variations in linguistic usage to sociocultural factors; ethno-semantics, social dialects, ethnography of speech, language standardization, multilingualism, language loyalties, problems of lingua franca, language planning, and policies in developing nations. Prerequisite: permission of the instructor. One course. Woolford. 11:30-1:00. 9.144

222. Topics in African Anthropology. Current research problems in African anthropology, illustrated by a study of tribal societies, in terms of contemporary theories. (Open only to students enrolled in the African Curriculum Development Project.) To be arranged. One course. O'Barr. 8:00-9:30.

Third Term

94. Cultural Anthropology. A study of the dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. One course. Carter. 9:45-11:15. 9.133

124. Peoples of the World: American Indian. A comprehensive survey of the Indians of North and South America, including a study of origins and prehistory, archaeology, racial affiliations, languages, material culture, social and political organization, economics, and religion, discussed in terms of the culture area. One course. Carter. 11:30-1:00. 9.133

Art

Professor Covi, Chairman (211 Art Building, East Campus); Professor Jenkins, Director of Undergraduate Studies (203 Art Building, East Campus)

First Term

66. Introduction to Modern Art. Development of architecture, sculpture, and painting in Europe and America from about 1750 to the present. One course. Markman. 8:00-9:20. 10.231

149. Pre-Columbian Art and Archaeology. Architecture, sculpture, pottery, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region of South America before the Spanish conquest. One course. Markman. 11:20-12:40. 10.231

Second Term

61. Introduction to the History of Architecture and Sculpture. One course. Hall. 8:00-9:30. B. 107

Biochemistry

Professor Hill, Chairman (255 Medical Sciences I); Professor Kirshner, Director of Graduate Studies (243 Medical Sciences I)

First Term (Durham Campus)

208. Laboratory Methods in Biochemistry. An advanced laboratory course that emphasizes current procedures, instrumentation, and experiments. Each student selects from a number of experiments of a wide range of classical investigations that illustrate significant biochemical progress. Hours to be arranged. One course (3 graduate units). Staff.

Second Term (Duke Marine Laboratory, Beaufort)

276. Comparative and Evolutionary Biochemistry. (Also Zoology 276.) Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, finger-printing, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. Two courses (6 graduate units.) Sullivan.

Biology*

Second Term

14. An Introduction to Biology. Nature of plants and animals, their origin, evolution, and development. Introduction to major concepts and methodology relevant to current problems. Open to freshmen with at least one year of biological science in high school and to all upperclassmen. Lectures and laboratories. One course. Staff. 9:45-11:15. Laboratory 2:00-5:00 Monday through Thursday. Lecture, 58.111; laboratory, 58.115

*See other courses listed under Botany and Zoology.

Black Studies Program

Professor Burford, Director (314 Carr Building, East Campus)

First Term

113. African Philosophy. Religious and political philosophy of twentieth century Africa. One course. Olela. 9:40-11:00. 9.144

125. Religion and Theology of Black America. Black religion in its historical and social context, with critical appraisal of major works. (Also listed as Religion 125.) One course. Burford. 1:20-2:40. 9.144

Botany

Professor Wilbur, Chairman (147 Biological Sciences); Professor Johnson, Director of Graduate Studies (354 Biological Sciences); Associate Professor White, Director of Undergraduate Studies (371 Biological Sciences)

Students admitted to candidacy for an advanced degree in botany should have completed a minimum of 12 semester-hours of courses in botany (or biology) beyond an elementary course, and related work in biological sciences. Students who have not yet had the minimum hours, however, may enter higher courses by permission of the instructor, if he is convinced that they can carry the work for undergraduate credit, and may count such work toward hours necessary for candidacy.

First Term (Durham Campus)

152. Plant Identification. Practice in the identification of local plants and a study of the principles underlying plant classification. Laboratory, lectures, and field trips. One course. Wilbur. 8:00-12:00. 58.154

156. Ecology of Plants. Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisite: introductory biology. One laboratory course. Christensen. 1:00-5:00. 58.154

242. Systematics. A general survey of the principles of vascular plant taxonomy, with practice in identification and collection. Lectures, laboratories, and field trips. Prerequisite: one year of biology. Four units. Wilbur. 8:00-12:00. 58.154

246. Ecology. Intensive study of the environmental effects on growth and distribution of plants at the level of the individual, the population, and the ecosystem. A term paper will be required. Lectures, laboratories, and field trips. Prerequisite: permission of instructor. 4 units. Christensen. 1:00-5:00. 58.154

226. Special Problems. Hours to be arranged. Staff.

360. Research. Hours to be arranged. Staff.

First Term (Duke Marine Laboratory, Beaufort)

225. Special Problems. Hours to be arranged. Staff.

359. Research. Hours to be arranged. Staff.

Second Term (Durham Campus)

103. General Bacteriology. A study of the morphology and fundamental physiological processes of bacteria: their relationship to sanitation, public

health, soil fertility, and food preservation. Prerequisite: introductory biology. One course. Johnson. 11:30-1:00. 58.256

225. Special Problems. Hours to be arranged. Staff.

359. Research. Hours to be arranged. Staff.

Second Term (Duke Marine Laboratory, Beaufort)

S205. Marine Microbiology. The biology of microorganisms in oceans and estuaries. Prerequisite: one year of college biological science. One and one-half courses. Blankley and Staff.

225. Special Problems. Hours to be arranged. Staff.

359. Research. Hours to be arranged. Staff.

Third Term (Durham Campus)

156. Ecology of Plants. Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisite: introductory biology. One laboratory course. Staff. 8:00-12:00. 58.112

246. Ecology. Intensive study of the environmental effects on growth and distribution of plants at the level of the individual, the population, and the ecosystem. A term paper will be required. Lectures, laboratories, and field trips. Prerequisite: permission of instructor. 4 units. Staff. 8:00-12:00. 58.112

226. Special Problems. Hours to be arranged. Staff.

360. Research. Hours to be arranged. Staff.

Third Term (Duke Marine Laboratory, Beaufort)

211. Marine Phycology. An introduction to marine algae; their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. One and one-half courses (6 graduate units). Hours to be arranged. Searles.

225. Special Problems. Hours to be arranged. Staff.

359. Research. Hours to be arranged. Staff.

Chemistry

Professor Quin, Chairman (101 Paul M. Gross Chemical Laboratory); Professor Chesnut, Director of Graduate Studies (330 Paul M. Gross Chemical Laboratory); Professor Wells, Director of Undergraduate Studies (333 Paul M. Gross Chemical Laboratory)

All classes in chemistry, Term I, will begin on May 20 and continue through June 15. Classes in Term II will begin on June 17 and continue through July 12.

First Term

11. Principles of Chemistry. A rigorous introductory course for students who intend to take additional courses in the department. Credit cannot be received for both sequences 1-2 and 11-12. Emphasizes stoichiometry and atomic and molecular structure. Laboratory work includes both qualitative and quantitative analysis. Prerequisites: one year of high school chemistry

and qualification for Mathematics 31. One laboratory course. Wilder. Laboratory daily, 9:30-12:30; recitation and lecture daily, 1:30-3:30. Laboratory 65.211; lecture and recitation, 65.103

132. Quantitative and Instrumental Analysis. Practice in advance quantitative analysis and in the use of chemical instrumentation in analysis. Theoretical and applied aspects of chemical and instrumental methods. Prerequisite: Chemistry 161 or its equivalent. One laboratory course. Lochmuller. Lecture daily 9:30-11:30 and laboratory Monday through Thursday from 12:30-4:45. Laboratory, 65.233; lecture, 65.104

151. Organic Chemistry. The structures and reactions of the compounds of carbon. Laboratory experiments illustrate the techniques of separation and structure determination. Prerequisite: Chemistry 12 or its equivalent. One laboratory course. Baldwin. Lecture daily, 9:30-11:30; laboratory Monday through Thursday, 12:30-4:30. Laboratory, 65.224; lecture, 65.103

275. Thesis Research. Research in the fields of physical, analytical, inorganic, or organic chemistry. Open to those students whose research programs for the M. A. and Ph. D. degrees have been approved by the department and by one of the instructors in charge of the course. Schedule to be arranged. (Not more than 1 unit of credit per week for full-time schedule or 1 unit each two weeks for half-time schedule.) 2 to 8 units. Available during Terms I, II, and III.

Second Term

12. Principles of Chemistry. Continuation of Chemistry 11. A rigorous introductory course for students who intend to take additional courses in the department. Credit cannot be received for both sequences 1-2 and 11-12. Emphasizes thermodynamics, chemical kinetics, synthesis, and analysis. Prerequisite: Chemistry 11 or its equivalent. One laboratory course. Bonk. Laboratory daily, 9:45-12:30; recitation and lecture daily, 1:30-3:30. Lecture and recitation, 65.111; laboratory, 65.211

152. Organic Chemistry. A continuation of Chemistry 151. The structures and reactions of the compounds of carbon. Laboratory experiments illustrate organic reactions and preparations. Prerequisite: Chemistry 151. One laboratory course. Jeffs. Lecture daily, 9:45-11:30; laboratory Monday through Thursday, 12:30-4:30. Lecture, 65.103; laboratory, 65.224

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry (Chemistry 161, 162, or equivalent), statistics (Mathematics 183, or equivalent), or permission of the instructor. (Given at Beaufort.) Includes lectures, laboratory work, and field trips. One and one-half laboratory courses. (3 graduate units). Baier.

Classical Studies

Professor Richardson, Acting Chairman (312 Carr Building, East Campus); Assistant Professor Rigsby, Director of Undergraduate Studies (204 Carr Building, East Campus)

First Term

51. Greek Literature in English Translation. Reading in translation of major Greek authors with emphasis on the Homeric epic and the Attic drama. One course. Burian. 9:40-11:00. 5.219

Comparative Literature

Professor Salinger, Chairman of the Committee on Comparative Literature
(106 Languages)

First Term

160. An Approach to Comedy. Nature, purpose, and effect of comedy in the theatre. Readings in English from the classics (Aristophanes, Plautus, and Terence), the Renaissance (Machiavelli, Shakespeare, Moliere, and Lope de Vega), the Restoration, and the twentieth century. (Also listed as Spanish 160). Graduate credit can be arranged. One course. Wardropper. 11:20-12:40. 5.219

Second Term

151. Theory and Form of Tragedy. A study of major theorists and an analysis of principal Greek, French, and English tragedies. (Also listed as French 151.) One course. Fowlie. 8:00-9:30. 5.014

191. Independent Study. Directed reading and research. Open only to qualified students in the junior year by permission of the department. One course. Salinger.

193. Independent Study. Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. Salinger.

205. Foundations of Twentieth Century European Literature. The roots of the contemporary scene (Proust, Mann, Rilke, Kafka, Lagerkvist, Camus, Gide, and Hesse) evolving toward a mythology of man. One course (3 graduate units). Salinger. 11:30-1:00 5.109

Computer Science

Professor Loveland, Chairman (407 Computation Center); Associate Professor Patrick, Director of Graduate Studies (408 Computation Center)

First Term

51. Introduction to Digital Computation. Flow charts; an assembly language; program structures, subroutines, data structures, arrays, polynomials; an algorithmic language; numerical linear algebra, matrix inversion, linear programming, and least-squares techniques. (Also listed as Mathematics 51.) One course. Patrick. 8:00-9:20. 49.113

222. Numerical Analysis II. Calculation of eigenvalues and eigenvectors, numerical methods for solving ordinary differential equations, partial differential equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) One course (3 graduate units). Patrick. 9:40-11:00. 49.113

Second Term

150. Computers and Programming. Computer structure, machine language, instruction execution, addressing techniques, and digital representation of data. Computer systems organization, logic design, micro-programming, and interpreters. Symbolic coding and assembly systems, macro definition and generation, and program segmentation and linkage. Prerequisite: Computer Science 51. One course. Staff. 9:45-11:15. 10.119

251. Computer Science for Teachers. An introduction to digital computation which concentrates on computer instruction in the high school and on the employment of computer processes in instruction and school administration. Prerequisite: a year of basic mathematical analysis at college level. One course (3 graduate units). Staff. 11:30-1:00. 49.120

Divinity School

Professor Thomas A. Langford, Dean (107B New Divinity School); Associate Professor James M. Efird, Director of Academic Affairs (101C New Divinity School)

Third Term

N.T. 103. Hellenistic Greek. Designed for beginners to enable them to read the Greek New Testament. 3 graduate units. Efird. 9:45-11:15. New Divinity School 011

O.T. 201. Introduction to Biblical Hebrew. Elements of phonology, morphology, and syntax. Exercises in reading and writing Hebrew. 3 graduate units. Bailey.

O.T. 202. Introduction to Biblical Hebrew and Hebrew Exegesis. Study of the weak verb; exegetical treatment of the book of Jonah. 3 graduate units. Bailey.

O.T. 201-202 will be taught as a 6 hour unit and will meet beginning on July 22 and continue through August 23. Class meeting time will be 9:00 a.m. -12:00 Noon, Monday through Friday. New Divinity School 02.

399. Also by special arrangement with an instructor a student may arrange for Independent Study in a given area of specialized research.

Economics

Professor Kelley, Chairman (315-A Social Sciences); Associate Professor Weintraub, Director of Graduate Studies (315 Social Sciences); Assistant Professor Black, Director of Undergraduate Studies (233 Social Sciences)

First Term

51. National Income and Public Policy. Basic economic analysis emphasizing current public policy issues. How the level and rate of growth of aggregate national income and output are determined. What causes unemployment, inflation, and international payments problems. How monetary policy (money supply and interest rates) and fiscal policy (government expenditures and taxes) affect these problems. One course. Black. 8:00-9:20. 10.227

108. Economics of War. Conflict theory, causes and economic consequences of war, military manpower, military-industrial complex disarmament and the economy. Prerequisite: Economics 52. One course. Weintraub. 11:20-12:40. 10.232

153. Monetary Economics. The evolution and operations of commercial and central banking and non-bank financial institutions in the United States, the determination of monetary aggregates and interest rates, the financial impacts of Treasury operations, and linkages from Federal Reserve actions to price level, employment, economic growth, and balance of payments objectives. One course. Yohe. 9:40-11:00. 10.227

Second Term

52. Competition, Monopoly, and Welfare. (See Economics 2.) For sophomores, juniors, and seniors. Not open to students who have had Management Sciences 50. One course. Salkin. 8:00-9:30. 10.227

53. Economics of Contemporary Issues. Modern economic problems, such as environmental deterioration and urban decay, viewed in context of the market which is in turn viewed as one of the interrelated subsystems of the social system and examined from institutionalist, Marxist, and other perspectives in the social sciences. One course. Havrilesky. 9:45-11:15. 10.227

106. Economics of Poverty. Poverty in the United States; its definition, measurement, history, racial dimensions, and present and proposed policies for its amelioration. Prerequisite: Economics 52. One course. Staff. 11:30-1:00. 10.227

149. Microeconomic Theory. Cost and supply considerations in price theory; the demand for factors of production. The allocation of resources is examined in the context of competitive and monopolistic market structures. (Not open to students who have had either Economics 161 or Public Policy Studies 110.) Graham. 9:45-11:15. 10.220

Education

Professor Hurlburt, Chairman (213-I West Duke Building, East Campus); Professor William H. Cartwright, Director of Graduate Studies (213-A West Duke Building, East Campus); Associate Professor Henry L. Sublett, Director of Undergraduate Studies (213-K West Duke Building, East Campus)

Duke University is accredited by the National Council of Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel, with the doctor's degree as the highest degree approved.

It is the intention of the department to make available to degree candidates all courses ordinarily required for certification as graduate teachers, counselors, principals, and superintendents. These courses will normally be offered at least once every three years.

First Term

100. Social and Philosophical Foundations of Education. A study of the basic features, assumptions, viewpoints, and issues of education in contemporary America. This course or Education 113 is required of all who intend to practice teach and of all majors in education and should be taken in the junior year. One course. Di Bona. 9:40-11:00. 53.225

Second Term

213. Elementary School Organization and Administration. This course is designed especially for principals, teachers, and other prospective members of the elementary school staff. The scope of elementary education is considered to encompass nursery school, kindergarten, and the elementary school. Special treatment is given to the problems of internal organization and management of the elementary school and its integration with the secondary school level. One course (3 graduate units). Sublett. 9:45-11:15. A. 212

222. New Developments in Elementary School Curriculum. The open

classroom, team teaching, non-graded programs, and individualized instruction. Assessment of recent emphasis on early childhood education and the middle school. One course (3 graduate units). Sublett. 8:00-9:30. A. 204

225. The Teaching of History and the Social Studies. Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course. (3 graduate units). Cartwright. 1:30-3:00. A. 204

233. Improvement of Instruction in English. This course will acquaint the student with recent developments in the teaching of English and will introduce him to research techniques in the field. Each student will pursue an extensive independent study based on his particular interests. One course (3 graduate units). Shuman. 11:30-1:00. A. 212

237. The Teaching of Literature in Secondary Schools. Literature generally taught in secondary schools. Adult and transitional literature are considered. Methods of organizing the program and of teaching literature. One course (3 graduate units). Shuman. 1:30-3:00. A. 202

246. Teaching of Mathematics. This course deals with such topics as aims, curriculum, course and lesson planning, and classroom procedure for teaching secondary school mathematics. One course (3 graduate units). Swain. 1:30-3:00. 49.124

249. Exceptional Children. A survey of the major categories of exceptional children—mental retardation, emotional disturbance, brain injured, learning disabilities, physically handicapped, visual and auditory deficits, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment will be discussed. One course (3 graduate units). Davis. 11:30-1:00. A. 202

253. Law and Education. This course examines elements and problems of educational organizations which have come within the purview of constitutional and legislative provisions and court decisions. Emphasis is placed on conflict among members of educational organizations and between educational organizations and other parties which has resulted in appellate court decisions. Students are expected to select appropriate problems for intensive study. One course (3 graduate units). Martin. 11:30-1:00. 4.027

260. Introduction to Educational Research. Research methodologies: experimental, historical, survey, philosophic, and case study. Fundamentals of statistical inference, research design, and computer applications to research problems. One course (3 graduate units). Katzenmeyer. 8:00-9:30. A. 202

276. The Teaching of High School Science. Discussion, lectures, and collateral reading, related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary school science. One course (3 graduate units). Githens. 1:30-3:00. Monday through Friday. A. 103

285. Audiovisual Aids in Education. The aims and psychological bases of audiovisual materials in the classroom. Attention to such materials as charts, filmstrips, flat pictures, maps, models, motion pictures, radio, records, slides, and television. One course (3 graduate units). Letro. 3:30-5:00. A. 202

303. Diagnostic and Educational Programs in Learning Disabilities. Diagnostic, intervention and remediation strategies, and program development

for the child with learning disabilities; review of major works in this field. Prerequisite: permission of instructor. 3 graduate units. Davis. 9:45-11:15. A. 08A

315. Seminar in Secondary School Teaching. Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit, this course must be accompanied by Education 216. 3 graduate units. Cartwright. 11:30-1:00. Rogers-Herr Junior High School

360. Seminar on Instructional Strategies. This seminar will present various theoretical and analytical models for comprehending teacher instructional strategies and teacher-student interaction in regard to their influence on the learning process. Students will review relevant research, analyze tapescripts and videotapes of classroom performance, and pursue applications of the models in a variety of settings. 3 graduate units. Katzenmeyer. 9:45-11:15. A. 202

Third Term

217. The Psychological Principles of Education. An advanced study of teaching, learning, and the learner. Selected problems guiding the reading of students will be discussed in class. One course (3 graduate units). Weitz. 1:30-3:00. A. 08A

219. Comparative and International Education: South Asia. Traditional and modern educational developments are studied in the cultural context of the region. Emphasis is placed on the social, political, and economic consequences of schooling in India and Pakistan. Open only to students enrolled in the South Asian Studies Seminar. To be arranged. 3 units. Di Bona.

221. Programs in Early Childhood Education. Examination of the objectives and philosophy underlying programs in early childhood education, including an overview of existing practices, research findings, and experimental projects dealing with social, emotional, physical, and cognitive development. One course (3 graduate units). Flowers. 8:00-9:30. 53.225

223. Teaching the Language Arts. Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. Increasing opportunities for creative expression. Correlation of language arts with other activities and school subjects. One course (3 graduate units). Adams. 11:30-1:00. 53.233

226. Teaching Developmental and Remedial Reading in the Elementary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. Practice is provided with elementary school children suffering reading retardation, in testing, diagnosis, and daily remedial teaching. One course (3 graduate units). Adams. 9:45-11:15. 53.233

234. Secondary School Organization and Administration. This course is designed especially for principals, teachers, and other prospective members of the secondary school staff. The scope of secondary education is considered to encompass junior high school, regular high school, senior high school, and junior college. Special treatment is given to the problems of internal organization and management. One course (3 graduate units). Pittillo. 9:45-11:15. 53.226

243. Personality Dynamics. A study of personality structure and dynamics with emphasis upon the implications for counseling and instruction. Prerequisites: 6 units of psychology or educational psychology. One course (3 graduate units). S. Gehman. 8:00-9:30. A. 202

250, 251. Teaching Emotionally Disturbed Children: Internship. Basic principles and practices in teaching and the organization of instructional materials. Work with children under the supervision of a certified teacher of emotionally disturbed children. Experience in general classroom teaching and small group and individualized instruction. Participation in staff conferences involving psychiatrists, psychologists, social case workers, and professional educators. One course (3 graduate units) each. S. Gehman. Hours to be arranged.

256. Classroom Assessment of Student Achievement. The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. One course (3 graduate units). Colver. 11:30-1:00. A. 202

321. Educational Management. A study of theory and practice of management as applied to education. This course is intended for anyone who has or is preparing to have major management responsibilities in the field of education. 3 graduate units. Pittillo. 11:30-1:00. 53.226

326. Educational Psychology: The Problem Child. Study of problem behavior and adjustment in children with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid to mental hygiene principles in the handling of problem children in school and home. 3 graduate units. I. Gehman. 9:45-11:15. A. 202

332. Supervision of Instruction. A study of the nature of supervision, underlying principles, and techniques of working with individual teachers and with groups. 3 graduate units. Hurlburt. 1:30-3:00. A. 202

Engineering

Professor Pearsall, Dean of the School of Engineering (136 Engineering Building; Professor Meier, Assistant Dean (136 Engineering Building); Assistant Professor George, Assistant Dean (136 Engineering Building)

First Term

B.M.E. 265. Advanced Topics in Biomedical Engineering. Advanced subjects related to programs within biomedical engineering, tailored to fit the requirements of a small group. Prerequisites: approval of the chairman and the instructor under whom work will be done. 1 to 4 units. Staff.

B.M.E. 399. Special Readings in Biomedical Engineering. Individual readings in advanced study and research areas of biomedical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. Graduate Staff.

C.E. 197-198. Projects in Civil Engineering. These courses may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisites: permission of the instructor and the Director of Undergraduate Studies. Each, half-course or one course. Staff.

C.E. 215. Urban and Regional Geography. The study and analysis of human settlements and locational patterns. Location theory and land-use systems. Normative and descriptive location decisions. The location and impact of

constructed facilities. Spatial interaction and network structure. The geography of transportation and environmental quality. One course. Dajani. 9:40-11:00. CE 117C

C.E. 365. Advanced Topics in Civil Engineering. Opportunity for study of advanced subjects relating to programs within the Civil Engineering Department tailored to fit the requirements of a small group. 1 to 3 units. Graduate Staff.

C.E. 399. Special Readings in Civil Engineering. Special individual readings in a specific area of study in civil engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. Graduate Staff.

E.E. 265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and of instructor under whom work will be done. 1 to 3 units. Graduate Staff.

E.E. 399. Special Readings in Electrical Engineering. Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. Graduate Staff.

M.E. 197-198. Projects in Mechanical Engineering. This course may be assigned by the Chairman of the department to outstanding seniors who express a desire for such work and who have shown aptitude for research in one distinct field of mechanical engineering. Prerequisite: 3.0 average and senior standing. One-quarter to two courses. Staff.

M.E. 265. Advanced Topics in Mechanical Engineering. Opportunity for study of advanced subjects related to programs within the Mechanical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and of instructor under whom work will be done. 1 to 3 units. Graduate Staff.

M.E. 300. Advanced Projects in Mechanical Engineering. This course may be elected by students enrolled in a non-thesis program leading to the Master of Science degree. 3 units. Graduate Staff.

M.E. 399. Special Readings in Mechanical Engineering. Special individual readings in a specified area of study in mechanical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. Graduate Staff.

English

Professor Budd, Chairman (325 Allen Building); Professor Nygard, Director of Graduate Studies (315 Allen Building); Professor Williams, Director of Undergraduate Studies (402 Allen Building)

Candidates for the master's degree in English are expected to have had at least 18 units in undergraduate courses above the sophomore level. The department may also require additional courses if the work of the student in his first term indicated inadequate preparation.

First Term

21S. Studies in the Novel. A study of the major forms of the novel, with particular emphasis on narrative techniques employed by nineteenth and twentieth century novelists. One course. Mellow. 11:20-12:40. 4.230

55. Representative British Writers. Chaucer's Prologue to The Canterbury

Tales and at least two tales, Shakespeare's *I Henry IV*, *Hamlet* or King Lear, and one other play, John Donne's poetry (selections), and Milton's *Paradise Lost* (selections) and some of the shorter poems. One course. Reiss. 9:40-11:00. 53.326

120. Stagecraft. An introductory course on the technical aspects of play production: scene design and construction, lighting, properties, make-up and costuming. Laboratory work will be coordinated with the various productions of Summer Theater at Duke. One course to be continued into Term II. To be arranged.

130. Play Production. An introduction to the methods of producing a play—theater organization, casting, rehearsal, staging and acting technique. The workshop will be coordinated with the program of Summer Theater at Duke. One course to be continued into Term II. To be arranged.

151. English Literature, 1901-1930. The principal writers of fiction, drama, and poetry including Conrad, Shaw, Yeats, Forster, Joyce, and Woolf. One course. Mellow. 8:00-9:20. 53.326

175. American Literature from 1860 to 1915. Dickinson, Twain, James, the social and philosophical essayists, Crane, Dreiser, Robinson, and Frost. (Not open to students who have taken English 58.) One course. Budd. 9:40-11:00. 53.327

181S. Conference on Drama. Modern dramatic literature. An investigation of major plays and playwrights of the past twenty-five years, including plays in the repertory of Summer Theater at Duke. The focus will be on the many approaches to dramatic form and the actor-audience relationship demonstrated by modern playwrights and directors. One course. Reardon. 11:20-12:40. 53.328

216. Chaucer. *Troilus and Criseyde* and the Minor Poems. One course (3 graduate units). Reiss. 11:20-12:40. 53.326

263. American Literature, 1800-1865. The writers emphasized are Emerson, Thoreau, and Hawthorne. One course (3 graduate units). Anderson. 8:00-9:20. 53.327

Second Term

56. Representative British Writers. Novels by Fielding (Joseph Andrews), Dickens (Great Expectations), and selections from the poetry of Pope, Wordsworth, Keats, and Yeats. One course. Adams. 9:45-11:15. 53.327

120. Stagecraft. Continued from Term I. To be arranged.

130. Play Production. Continued from Term I. To be arranged.

152. English Literature of the Twentieth Century. The principal writers of fiction, drama, and poetry including Lawrence, Cary, Huxley, Auden, Greene, Beckett, and Dylan Thomas. One course. Smith. 8:00-9:30. 53.327

176. American Literature since 1915. Poetry, fiction, drama, and critical prose from Stein, Anderson, O'Neill, Hemingway, and Faulkner to such contemporary authors as Malamud and Robert Lowell. One course. Strandberg. 9:45-11:15. 53.326

182S. Conference on Poetry. A study of The Canterbury Tales with attention to literary genres, unifying themes, and overall structure. Some background readings in Augustine, Boethius, and the Courtly Love tradition will also be required. One term paper; a final exam. One course. DeNeef. 11:30-1:00. 53.328

208. History of the English Language. Introductory survey of the changes in sounds, forms, and vocabulary of the English language from its beginnings to the present, with emphasis on the evolution of the language as a medium of literary expression. One course (3 graduate units). Nygard. 8:00-9:30. 53.326

276. American Literature since 1915. Poetry from the Imagist movement to the present. One course (3 graduate units). Duffey. 9:45-11:15. 53.318

353. Studies in British Poetry of the Twentieth Century. Detailed examination of the poetry of W. B. Yeats. 3 graduate units. Smith. 11:30-1:00. 53.326

Third Term

174. American Literature from 1800 to 1860. Prose and poetry of American Romanticism: Emerson, Thoreau, Hawthorne, Poe, Melville, and Whitman. (Not open to students who have taken English 57). One course. Jones. 9:45-11:15. 53.326

183S. Conference on Fiction. Studies in the Literature of Fantasy. Analysis of themes, forms, and sources of representative works of fantasy with emphasis on twentieth century examples. One course. Monsman. 11:30-1:00. 53.328

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. One course (3 graduate units). Butters. 1:30-3:00. 53.327

229. English Literature in the Seventeenth Century. Emphasis in poetry on Jonson and the cavaliers, Donne and the metaphysicals; in prose on character writers, and Bacon, Burton, Donne, and Browne. One course (3 graduate units). DeNeef. 8:00-9:30. 53.327

245. English Literature of the Later Nineteenth Century. The writers emphasized are Carlyle, Dickens, Thackeray, Tennyson, and Browning. One course (3 graduate units). Monsman. 9:45-11:15. 53.327

264. American Literature, 1800-1865. The writers emphasized are Poe and Melville. One course (3 graduate units). Jones. 11:30-1:00. 53.328

280. Introduction to Folklore. A survey of the materials of popular tradition; the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. One course (3 graduate units). Nygard. 9:45-11:15. 53.318

Forestry

Professor Ralston, Dean of the School of Forestry (213 Biological Sciences Building, West Campus); Professor Anderson, Director of Graduate Studies (04 Biological Sciences Building, West Campus)

Qualified students may engage in thesis research in certain branches of forestry during the summer session with the approval of the instructor concerned and the Dean of the School of Forestry, or of the Director of Graduate Studies in the case of work taken through the Graduate School.

357. Research in Forestry. Open to students whose research programs for the M.F. or D.F. degree have been approved by the Dean of the School of Forestry and the instructor responsible for directing the research and whose

programs for the A.M., M.S., or Ph.D. degree have been approved by the Director of Graduate Studies and the instructor in charge. (Credits and schedule to be arranged.) May 14-August 17, 2 to 12 units. (Not more than 1 unit of credit per week for full-time schedule or 1 unit each two weeks for half-time schedule.) Consult courses 301-302 in the Bulletin of the School of Forestry for the letter designation of branches of forestry in which research is to be conducted. Staff.

Geology

Professor Heron, Chairman (118 Science Building, East Campus); Associate Professor Perkins, Director of Graduate Studies (111 Science Building, East Campus); Associate Professor Furbish, Director of Undergraduate Studies (104 Science Building, East Campus)

First Term (Durham Campus)

3. Environmental Geology. Earth processes including geologic hazards; earth materials, including mineral resources, as related to man. Not open to those who have completed Geology 1. One course. Heron. 11:20-12:40. C. 116

Third Term (Duke Marine Laboratory, Beaufort)

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distributions, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. (This course is not open to students who have completed Geology 206.) One and one-half course (6 graduate units). Pilkey.

German

Professor Phelps, Chairman and Director of Graduate Studies (102 Language Building); Assistant Professor Novak, Director of Undergraduate Studies (111 Language Building)

The work in German 1, 2 and 63 will be coordinated with listening and oral practice in the language laboratory which students in German classes will be privileged to attend.

First Term

1. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. One laboratory course. Alt. 11:20-12:40 and Tuesdays and Fridays 2:00-3:20. 5.109

63. Intermediate German. Grammar review and composition; reading of short stories, novels, and poems. Prerequisite: German 1-2 or two units of high school German. One laboratory course. Alt. 9:40-11:00 and Mondays and Thursdays, 2:00-3:20. 5.109

191. Independent Study. Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. Staff. Hours to be arranged.

Study Abroad Program. Six-week program (May 20-July 6, 1974). In Münster, Germany. Two course credits allowed. Director: Mr. Gunter Klubes. For complete details, contact Mr. Klubes or Chairman of German Department.

Second Term

2. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. Prerequisite: German 1 or equivalent. One laboratory course. Stern. 11:30-1:00 and Tuesdays and Fridays, 2:00-3:20. 5.08

101. Introduction to German Literature. Readings from representative German authors. One course. Alt. 9:45-11:15. 5.014

103S. Seminar in German Literature in English Translation. One course. Bessent. 9:45-11:15. 5.08

117. German Conversation. A course primarily in speaking German with some practice in writing. One course. Bessent. 8:00-9:30. 5.08

192. Independent Study. Directed reading and research. Open only to qualified students in the junior year by permission of the department. One course. Staff. Hours to be arranged.

194. Independent Study. Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. Staff. Hours to be arranged.

Graduate Reading Course. An intensive study course in German to develop rapidly the ability to read technical German in several fields. For graduate students only. No degree credit. Stern. 9:45-11:15. 5.109

Health Administration

Professor Jaeger, Chairman (262 Baker House); Assistant Professor Smith, Director of Graduate Studies (234B Baker House) All courses extend throughout the summer session and are closed to students in departments other than Health Administration.

322. Public Policy and Health Care. A study of the development and present status of selected public policy issues within their social, economic, and political contexts. Alternative courses of possible public action are reviewed and their probable outcomes are assessed. 2 credits. Jaeger.

324. Institutional Health Services. A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other long-term care institutions. Specific study is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; the planning function; and the evaluation of performance. 5 credits. Staff.

329. The Clerkship. The clerkship is designed to provide the student an opportunity to experience and develop perspective on the interplay of various forces and problems within the field of health services delivery. Each student rotates through six different settings that are selected as focal points for significant combinations of people, problems, and resources. Within each setting the student, under faculty supervision, is responsible for the conduct of certain administrative functions in order to increase his ability to solve real problems and improve his personal judgment. 1-2 credits. Staff.

348. Legal and Regulatory Constraints on Health Services. This course treats the legal relationships between elements of the health system and the larger society of which it is a part. Attention is devoted to the certifica-

tion, operation, and performance of health manpower, organizations, and services, and the difficulties in establishing effective restraints to minimize undesired results. The approach to the course includes the study of selected legislation, court cases, and research findings that assist in understanding formal constraints that affect the operation of the health system. 2 credits. Staff.

Health and Physical Education (Men)*

Professor Friedrich, Chairman (105 Card Gym); Associate Professor Skinner, Director of Undergraduate Studies (106 Card Gym)

First Term

120. Beginning Swimming. Basic fundamentals and strokes of swimming are taught. One-fourth course. To be arranged. Persons. Gym

125. Swimming and Life Saving. In this course students may complete requirements to obtain Red Cross Life Saving Certificate. One-fourth course. To be arranged. Persons. Gym

130. Golf. Basic fundamentals and shots in golf are taught. Students use practice driving range and putting green as well as Duke Golf Course. One-fourth course. To be arranged. Myers.

140. Tennis. Primary emphasis is on tennis strokes, fundamentals, and game strategy. One-fourth course. To be arranged. LeBar.

171. Recreational Leadership. Theories and philosophies of play and recreation with emphasis on leadership techniques with program administration and application to community organizations, school, and government sponsored programs. One course. Friedrich. 9:40-11:00. Gym

172. The Administration of Health, Physical Education, and Athletics in Secondary Schools. One course. Friedrich. 11:20-12:40. Gym

Second Term

173. Protective Practices in Physical Education and Athletics. Training and conditioning of athletic teams and the prevention, diagnosis, and treatment of athletic injuries. One course. Riebel. 8:00-9:30. Gym

History

Professor Colton, Chairman (235 Allen Building); Professor Young, Director of Graduate Studies (237 Allen Building); Professor Hollyday, Director of Undergraduate Studies (227 Allen Building)

First Term

21. Europe Past and Present. Major problems in the development and world impact of European civilization. First semester: to the eighteenth century. One course. Mulligan. 8:00-9:20. 53.225

91. The Development of American Democracy to 1865. A study of the trends vital to an understanding of the United States today with attention to foreign policy, the growth of capitalism, political practices, social reform, and conflicting ideals. One course. Greeman. 9:40-11:00. 53.226

*Courses are open to men or women.

144. History of Modern Japan. Japan from 1867 to the present; the transition from the traditional to the modern state. One course. Silberman. 9:40-11:00. 53.229

162. History of Russia. From Tsarist to Soviet Russia. One course. Griffiths. 11:20-12:40. 53.233

239. History of Socialism and Communism. Origins and development of socialist and communist movements. One course (3 graduate units). Griffiths. 9:40-11:00. 53.233

Second Term

22. Europe Past and Present. From about 1800 to the present. One course. Cell. 8:00-9:30. 53.234

92. The Development of American Democracy, 1865 to the Present. Emphasis upon the emergence of contemporary problems. One course. Nelson. 8:00-9:30. 53.226

151. Modern Technology. Emphasis on Western technology in the nineteenth and twentieth centuries as related to political, economic, and scientific trends. One course. Ropp. 11:30-1:00. 53.229

214. European Imperialism and the Response in Asia and Africa. Theory, structure, and impact of European colonial rule in the nineteenth and twentieth centuries; response and resistance; emergence of nationalism; and decolonization. One course (3 graduate units). Cell. 11:30-1:00. 53.234

219. Historical and Contemporary African Society. One course (3 graduate units). Stoff. Open only to students enrolled in the African Curriculum Development Project. 9:45-11:15. To be arranged.

246. Military History. War, politics, and technology in the modern world. One course (3 graduate units). Ropp. 8:00-9:30. 53.229

248. History of Modern India and Pakistan, 1757 to Present. Analysis and interpretation with special emphasis on changes in social and economic life. Open only to students enrolled in the South Asian Studies Seminar. To be arranged. 3 units. Colkins

264. The American Revolution. Background, progress, and results of the Revolution. One course (3 graduate units). Nelson. 11:30-1:00. 53.226

277. The Era of the Civil War. Emphasis will be on sectionalism and the coming of the war. One course (3 graduate units). Stark. 9:45-11:15. 53.225

Third Term

131. Mexico and the Caribbean from the Wars of Independence to the Present. One course. TePoske. 9:45-11:15. 53.229

229. Recent Interpretations of Modern European History. Analysis and discussion of key historical problems in European history from the Renaissance to the present. One course (3 graduate units). Colton. 11:30-1:00. 53.234

230. History of Spain. Late medieval period to the present. One course (3 graduate units). TePoske. 8:00-9:30. 53.229

240. Aspects of Traditional and Modern African Culture. Introduction to oral and written literatures and musical and artistic traditions. One course (3 graduate units). Hortwig. Open only to students enrolled in the African Curriculum Development Project. 8:00-9:30. To be arranged.

255S. Problems in African History. One course (3 graduate units). Hortwig. Open only to students enrolled in the African Curriculum Development Project. 9:45-11:15. To be arranged.

278. The Era of the Civil War and Its Aftermath. One course. Durden. 9:45-11:15. 53.234

Management Sciences

Professor Laughhunn, Chairmon (115 Social Sciences Building); Assistant Professor Kuhn, Director of Undergraduate Studies (08 Social Sciences Building)

First Term

100. Introduction to Financial Accounting. Conceptual framework of external financial reporting, focusing on the nature and purpose of accounting, the measurement of status and activity in economics terms, and the interpretation of published financial statements. Prerequisite: sophomore standing. One course. Staff. 8:00-9:20. 10.232

120. Organization Theory. Introduction to recent theories of and research on the structure and behavior of complex organizations, with special reference to business firms. Topics to be covered include: rationality, authority, bureaucracy, and other concepts; power, decision-making, informal organization, organization change, and other internal process phenomena; effects of technology, culture, and other environmental influences, brief consideration of organization design. Prerequisites: Management Sciences 50 and 60. One course. Stoff. 11:20-12:40. 10.229

Mathematics

Professor Warner, Chairmon (135C Physics Building); Associate Professor Burdick, Director of Graduate Studies (135D Physics Building); Professor Dressel, Director of Undergraduate Studies (135A Physics Building)

First Term

31. Introductory Calculus. Limits, differentiation, and integration with applications to physical problems. Prerequisite: three years of college preparatory mathematics. One course. Ekmon. 11:20-12:40. 49.120

53. Basic Statistics. Principal statistical methods including application to psychological, economic, business administration, and educational problems. Techniques of data collection and presentation, hypothesis testing, using the chi-square, t, and F distributions, interval estimation and linear regression. Not open to students who have had Economics 138 or Psychology 117. One course. Burdick. 9:40-11:00. 49.132

Second Term

32. Introductory Calculus. Transcendental functions, sequences, series, Taylor's formula. Prerequisite: Mathematics 31. One course. Hodel. 11:30-1:00. 49.124

216. Intermediate Analysis. Series; uniform convergence, integration. Theory of functions of a real variable. One course (3 graduate units). MacKichon. 8:00-9:30. 49.124

220. Advanced Linear Algebra with Applications. Solutions of systems of

linear inequalities; applications to linear programming and game theory; computation of eigenvalues and eigenvectors. One course (3 graduate units). Weisfeld. 9:45-11:15. 49.124

Third Term

19. Pre-Calculus Mathematics. Selected topics in algebra, trigonometry, and analytic geometry. Students with CEEB achievement scores in mathematics below 530 need this skill course before taking Mathematics 31. Prerequisite: two units of college preparatory mathematics. One course. L. Smith. 9:45-11:15. 49.124

204. Geometry for Teachers. Metric and synthetic approaches to plane and solid geometry; affine geometry, an algebraic model of Euclidean geometry. One course (3 graduate units). D. Smith. 9:45-11:15. 49.128

219. Advanced Modern Algebra. Fields, vector spaces, and groups; Galois theory; theory of equations. Prerequisite: some familiarity with modern algebra and linear algebra. One course (3 graduate units). Warner. 11:30-1:00. 49.128

Microbiology

Second Term

325. Medical Mycology. A lecture and laboratory course with emphasis on those fungi which cause disease in man and animals. The course includes practical laboratory work with materials from patients in Duke Hospital and those sent to the Duke Fungus Registry from outside sources. July 1-27, 1974. Lecture daily, Monday-Saturday, 8:00-9:00 a.m.; laboratory, Monday-Friday, 9:00-12:00 and 1:30-4:30 p.m., Saturday 9:00-12:00. 4 units. Conant.

Music

Professor Bone, Chairman (206 Bivins Building); Professor Hanks, Director of Undergraduate Studies (111 Asbury Building)

First Term

125. Masterworks of Music Literature. An intensive study of selected masterworks which represent the principal currents in modern music history. Compositions by Bach, Mozart, Beethoven, Brahms, Debussy, and Bartok will constitute a frame of reference for historical, biographical, and stylistic analysis. One course. Mueller. 8:00-9:20. 53.234

164. Music in the Nineteenth Century. The interaction of musical, artistic, and literary movements in the cultural life of the century. One course. Mueller. 9:40-11:00. 53.234

Applied Music Courses. Applied music courses in piano, organ, and voice may be arranged. One-half or one course. Staff. (Available during all three terms of the summer session.)

Second Term

181, 182. Independent Study in Musical Performance. Intensive coaching and performance in chamber music at Kneisel Hall, Blue Hill, Maine. See Music Department for dates and fees. Two courses. Ciompi and Mueller.

Nursing

Professor Wilson, Dean (1005 School of Nursing, West Campus); Associate Professor Most, Director of Academic Programs (1004 School of Nursing, West Campus)

First Term

191, 192, 193, or 194. Independent Study. Demonstration of self-direction in planning, implementing, evaluating, and reporting an independent learning experience. The required study for nursing majors must focus on nursing. Minimum of one course. Pass/fail option. Staff.

Second Term

191, 192, 193, or 194. Independent Study. (See description given in Term I.) Staff.

Third Term

173. The Child with Diabetes: A Living-Learning Experience. This practicum offers opportunity to care for ambulatory children with diabetes mellitus in a residential summer camp setting. The focus is on principles of diet, medication, and activity modification in management of labile juvenile diabetes and on facilitating self-care by the child with a chronic disease. Open to rising seniors in the nursing major. (Also listed as MED-262 (C).) One course. Pass/fail option. To be arranged. Staff.

177. Administrative Concepts Applied to the Team Leadership Role. Designed to assist the student to use concepts of administration in the team leadership role within a hospital nursing service. Two courses. Pass/fail option. Open to rising seniors in the nursing major. To be arranged. Fortune.

191, 192, 193, or 194. Independent Study. (See description given in Term I.) Staff.

Pathology

Professor Kinney, Chairman (M301, Davison Building); Professor Sommer, Director of Graduate Studies (301 Davison Building)

First Term

M357. Research. Hours to be arranged. Staff.

M361. Advanced General Pathology. See Bulletin of the Graduate School for description. 6 units. Staff.

Second Term

M357. Research.

M362. Advanced General Pathology. Second part of M361.

Third Term

M357. Research. Hours to be arranged. Staff.

Philosophy

Professor Welsh, Chairman (201-K West Duke Building, East Campus); Associate Professor Mahoney, Director of Graduate Studies (201J West Duke

Building, East Campus); Assistant Professor Aquila, Director of Undergraduate Studies (201-G West Duke Building, East Campus)

First Term

94. History of Modern Philosophy. Bacon, Hobbes, Decartes, Spinoza, Leibniz, Locke, Berkeley, Hume, and Kant. Freshman prerequisites: previous philosophy course and permission of the instructor. One course. Aquila. 11:20-12:40. 9.129

106. Philosophy of Law. Natural law theory; legal positivism; legal realism; the relation of law and morality. One course. Benditt. 9:40-11:00. 9.129

Second Term

112. Philosophy of Mind. Such topics as mind and body, thought and language, persons, and personal identity. One course. Welsh. 11:30-1:00. 9.133

Physics

Professor Newson, Chairman (119 Physics Building); Associate Professor Evans, Director of Graduate Studies (111 Physics Building); Associate Professor Roberson, Director of Undergraduate Studies (412 TUNL)

First Term

51. General Physics. This course treats the basic principles of general physics in a quantitative manner. It meets in a thorough way the physics requirement for entrance into the study of either medicine or engineering, and is well suited for the general science student. This course is not open for credit for students who have completed Physics 41-42. Prerequisites: Mathematics 31, 32 or equivalent. One laboratory course. Stoff. 9:30-4:00. 49.114

Second Term

52. General Physics. A continuation of Physics 51. Prerequisite: Physics 51. One laboratory course. Stoff. 9:45-4:00. 49.114

161. Modern Physics. Relativity, quantum phenomena, atomic and molecular structure and spectra, solids, statistical physics, nuclear physics, and elementary particles. Prerequisites: Physics 41-42 and Mathematics 32. One course. Hon. 9:45-11:15. 49.126

Physiology

Professor Tosteson, Chairman (388 Medical Sciences I); Associate Professor McManus, Director of Graduate Studies (354 Medical Sciences I)

Third Term (Duke Marine Laboratory, Beaufort)

212L. Membrane Physiology and Osmoregulation. Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. The course includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in marine plants and animals. Laboratory work deals with ionic transport processes in gills and other epithelia, basic electrophysiology and synaptic transmission in mollusks, kidney function in fish, amino acid transport and metabolism in crustaceans, and the application of radio-tracer and other physical and chemical

techniques to the study of membrane function. Prerequisite: permission of instructor. One and one-half courses (6 graduate units). Gutknecht and Others.

Political Science

Professor Barber, Chairman (214 Perkins Library); Professor Fish, Director of Graduate Studies (308 Perkins Library); Professor Hall, Director of Undergraduate Studies (314 Perkins Library)

First Term

128S. Congress and the Presidency. Policy-making in the executive and legislative branches of the United States government, with particular attention to intra-governmental relations. One course. Price. 9:40-11:00. 4.307

Second Term

61. The American Political System. Theory and practice of American government and politics. Federal-state relations, the separation and interrelationships of the executive, legislative, and judicial branches of government, judicial review, the role of political parties and public opinion, the formulation and execution of domestic and foreign policy, civil liberties. One course. Holl. 8:00-9:30. 4.301

246. Administration and Public Policy. The role of administration in the American policy process. One course (3 graduate units). Hall. 9:45-11:15. 4.301

Third Term

127. Law and Society. Nature and functions of law; Anglo-American legal institutions, the process of judicial decision-making, and the relationships among judges, lawyers, legislators, and administrators in the development of public as well as private law. One course. Fish. 9:45-11:15. 4.301

Psychology

Professor Alexander, Chairman (244 Sociology-Psychology); Professor Lockhead, Director of Graduate Studies (221 Sociology-Psychology); Professor Lakin, Director of Undergraduate Studies (324 Sociology-Psychology)

Details concerning the program of studies in psychology may be obtained from the brochure Graduate Studies in Psychology.

First Term

93. Biological Basis of Behavior. Behavior as a product of evolution and the role of behavior in species survival. Neural and endocrine factors in reproduction, hunger, thirst, emotion, and intelligence. Heredity-environment in the development of behavior. One course. Guttmann. 11:20-12:40. 9.127

94. Personality. Representative theories of personality from Freud to the present, emphasizing problems of normal personality structure, dynamics, development, and assessment. Not open to students who have had Psychology 116. One course. Lakin. 9:40-11:00. 9.127

101. Social Psychology. Problems, concepts, and methods in the study of social interaction and interpersonal influence. Prerequisite: one course in psychology at the 90-level or permission of the instructor. One course. Levy. 8:00-9:20. 9.127

165. Personality Theory. Theories of personality from larger meta-theoretical perspectives. Open to junior and senior majors in psychology, or by permission of the instructor. Prerequisite: Psychology 94. One course. Kremen. 9:40-11:00. 9.133

Second Term

92. Sensation, Perception, and Learning. Sensation, including psychophysics and receptor processes. The concept of reflex, both physiological (Sherrington) and behavioral (Pavlov). Complex organization: learning, perception, and cognition. One course. Lockhead. 11:30-1:00. 9.126

138. Abnormal Psychology. Disordered behavior and constructive personality change are viewed in interpersonal and social context for purposes of understanding normal and abnormal personality development and functioning. Prerequisite: Psychology 94 or 95. One course. Carson. 9:45-11:15. 9.126

253. Personality Development. A survey of behaviors and concepts relating to personality functioning with special emphasis on infancy, childhood, and adolescence. One course (3 graduate units). Staff. 8:00-9:30. 9.126

Third Term

95. Developmental Psychology. Theory and research on growth and behavior from infancy to adolescence; special emphasis on personality and cognitive development. One course. Whatley. 11:30-1:00. 9.127

Religion

Professor Poteat, Chairman (117B Gray); Professor Young, Director of Graduate Studies (209A Divinity); Associate Professor Partin, Director of Undergraduate Studies (219 Gray)

First Term

125. Religion and Theology of Black America. Black religion in its historical and social context, with critical appraisal of major works. (Also listed as Black Studies 125.) One course. Burford. 1:20-2:40. 9.144

128. The Background of Contemporary Christian Thought: 1918-1950. Theology of Karl Barth, Rudolf Bultmann, Paul Tillich, Karl Rahner, Reinhold Niebuhr, and others. One course. Osborn. 8:00-9:20. 3.228

140. Religions of India. Major religious traditions of the sub-continent. Hinduism, Buddhism, Jainism, and Islam. One course. Lawrence. 9:40-11:00. 3.228

151. Ethical Issues in Social Change and Public Policy. American moral tradition and factors in social change in the normative analysis of public policy, with a consideration of specific ethical issues. One course. McCollough. 11:20-12:40. 3.228

Second Term

57. Introduction to the History of Religions. Historico-religious study of primitive religions. Hinduism, Buddhism, Islam, and other religions. One course. Bradley. 8:00-9:30. 3.319

120. History of the Christian Church. Crucial events, issues, forms, and

writings that have shaped the Christian community and influenced Western civilization from the time of the early church. One course. Jones. 9:45-11:15. 3.319

188. Recent Literature and its Religious Implications. Religious elements in recent literature. One course. Kort. 11:30-1:00. 3.319

315. History of Religions: South Asia. Selected problems in the field. Open only to students enrolled in the South Asian Studies Seminar. To be arranged. 3 units. Lawrence

JUDAIC STUDIES SUMMER PROGRAM IN ISRAEL

Program I: Participation in the Duke-American Schools of Oriental Research Expedition to Meiron, Upper Galilee, Israel, for six weeks with a May 30 departure.

131D. Principles of Archaeological Investigation. (Formerly Religion 101D.) Supervised field work, visits to other excavations, introduction to ceramic chronology, numismatics, and other related disciplines. Excavation of a late Roman village in Galilee. Offered in Israel only in the summer. One course. Meyers.

132D. Palestine in Late Antiquity. (Formerly Religion 102D.) The history, literature, and archaeology of Roman Palestine with particular emphasis on Galilee in rabbinic and early Christian time. One course. Meyers.

Program II: Participation for three weeks in excavations at Meiron, with three week seminar on "Israel and Judaism" in Jerusalem with a May 30 departure.

132D. Palestine in Late Antiquity. (Formerly Religion 102.) The history, literature, and archaeology of Roman Palestine with particular emphasis on Galilee in rabbinic and early Christian time. One course. Bland.

196C. Junior-Senior Seminar: Judaic Studies. One course. Bland.

Program III: Participation for three weeks in excavations at Meiron with a June 20 departure.

131D. Principles of Archaeological Investigation. (Formerly Religion 101D.) Supervised field work, visits to other excavations, introduction to ceramic chronology, numismatics, and other related disciplines. Excavation of a late Roman village in Galilee. Offered in Israel only in the summer. One course. Meyers.

For further details on the program, please contact Professor Eric M. Meyers, P. O. Box 4735, Duke University, Durham, North Carolina 27706.

Third Term

124. Christianity in America. Representative men, movements, and thought in American Christianity. One course. Jones. 9:45-11:15. 3.228

143. Mysticism. The mystical element in religion: Hinduism, Buddhism, Christianity, and Islam. One course. Bradley. 11:30-1:00. 3.228

Romance Languages

Professor Tetel, Chairman (205A Language Center); Associate Professor Patrick Vincent, Director of Graduate Studies (214 Language Center)

FRENCH

First Term

76. Introductory French Conversation. Practice in everyday conversational French. Prerequisite: French 63 or equivalent. Limited to fifteen students. One course. Steegar. 11:20-12:40. 5.208

141S. Studies in Myth and Legend. Transformations of mythical figures such as Orpheus, Phaedra, and Don Juan from antiquity to modern times in forms ranging from tragedy to film. Graduate credit can be arranged. One course. Auld. 11:20-12:40. 4.307

181. Intensive French. An intensive introduction to the language. One course. Staff. 9:40-11:00. 5.217

Graduate Reading Course. An intensive course in French to develop rapidly the ability to read French in several fields. Graduate students only. No credit. One course. Tetel. 4:00-5:20. 5.208

Second Term

100. Active French. Intensive instruction in oral and written expression. Prerequisite: French 76 or equivalent. Limited to fifteen students. One course. Bryan. 11:30-1:00. 5.208

151. Theory and Form of Tragedy. A study of major theorists and an analysis of principal Greek, French, and English tragedies. (Also listed as Comparative Literature 151.) Readings in English or French. Graduate credit can be arranged. One course. Fowlie. 8:00-9:30. 5.014

182. Intensive French. Readings in modern literature. One course. Staff. 9:45-11:15. 5.208

SPANISH

First Term

76. Introductory Spanish Conversation. Practice in everyday conversational Spanish. Prerequisite: Spanish 63 or equivalent. Limited to fifteen students. One course. Garci-Gomez. 11:20-12:40. 5.211

160. An Approach to Comedy. An exploration of the nature, the purpose, and the effect of comedy in the theatre. Readings, in English, will be from the classics (Aristophanes, Plautus, and Terence), the Renaissance (Machiavelli, Shakespeare, Moliere, and Lope de Vega), the Restoration, and the twentieth century. (Also listed as Comparative Literature 160.) Graduate credit can be arranged. One course. Wardropper. 11:20-12:40. 5.219

181. Intensive Spanish. An intensive introduction to the language. One course. Staff. 9:40-11:00. 5.208

Second Term

100. Active Spanish. Intensive instruction in oral and written expression. Prerequisite: Spanish 76 or equivalent. Limited to fifteen students. One course. Landeira. 11:30-1:00. 5.211

156. The Spanish American Novel. Masterworks of the twentieth century. Graduate credit can be arranged. Readings in English or Spanish. One course. Fein. 9:45-11:15. 5.211

182. Intensive Spanish. Readings in Modern literature. One course. Staff. 9:45-11:15. 5.015

Science and Mathematics Institute

Among other offerings listed elsewhere in this Bulletin, the following will be included if an institute is funded by the National Science Foundation or upon sufficient demand.

Second Term

Chemistry 211, 212. Chemistry for Teachers I and II. A study of the principles of modern chemistry with particular reference to the environmental, ecological, and interdisciplinary aspects of modern technology. Open only to teachers of biology, chemistry, and general science. Lecture, recitation, and laboratory or field trips daily. 6 units. Wilder. 8:00-4:00. To be arranged.

Third Term

Physical Science 201. Physical Science for Teachers I. A quantitative study of the primary physical and electrical properties of matter and forms of energy, emphasizing processes of measurement and analysis. Open only to teachers. July 18-August 8. To be arranged. 3 units. Githens. 8:00-4:00.

Sociology

Professor Kerckhoff, Chairman (268 Sociology-Psychology); Associate Professor Wilson, Director of Graduate Studies (271 Sociology-Psychology); Assistant Professor House, Director of Undergraduate Studies (277A Sociology-Psychology)

First Term

91. Introduction to Sociology: Concepts and Procedures. Concepts and procedures of sociology and illustrations of their use in understanding specific areas of social life. Open to freshmen. One course. Tirayakian. 9:40-11:00. 9.248

173. Social Movements. Social movements as agents of change. Structure and development of protest groups. One course. Wilson. 8:00-9:20. 9.248

Second Term

143. Deviant Social Behavior. Analysis of deviant behavioral systems (illness, crime, and delinquency) in terms of precipitating social factors, patterns and goals, and remedial and counteracting controls. One course. Preiss. 8:00-9:30. 9.129

272. The Socialization Process. Mechanisms and variations in socialization by position in the social structure (class, caste, and urban-rural); contributions made by various socialization agencies (family, school, peer groups, and mass media) in Western society. One course. Preiss. 11:30-1:00. 9.129

Third Term

155. Sociology of Work. Study of the social organization or work activities of the human experiences and group relationships involved. Special focus on management-employee conflict and cooperation. One course. Fenton. 8:00-9:30. 9.127

255. Race and Culture. A comparative study of race relations in world

perspective developed around such themes as race and personal identity, the geography and ecology of race relations, and the idea of race, and race conflict. One course (3 graduate units). Borinski. 9:45-11:15. 9.144

259. Religion and Social Change. The role of religion in significant social changes in Western and non-Western societies; noninstitutional phenomena (charisma, prophecy, messianism, revivals, and glossolalia). Prerequisite: either Anthropology 264, Sociology 151, or the equivalent. One course (3 graduate units). Borinski. 11:30-1:00. 9.144

Zoology

Professor Fluke, Chairman (on leave 1973-74); Professor Bailey, Acting Chairman (227 Biological Sciences); Associate Professor Wainwright, Director of Graduate Studies (024 Biological Sciences); Associate Professor Ward, Director of Undergraduate Studies (032 Biological Sciences)

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking B.A., B.S., M.A., or Ph.D. degrees.

Students seeking undergraduate degrees should consult the Bulletin of Undergraduate Instruction for a statement of major requirements. A departmental handbook available from the office of the Director of Undergraduate Studies describes the advising system, typical courses of study, special programs, and interests and background of the faculty.

In general, a graduate student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology, along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the Bulletin of Undergraduate Instruction and the Bulletin of the Graduate School for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology, and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology and Anthropology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

For registration dates see General Registration pages 29-30 of this Bulletin. For detailed instructions and further information on the offerings at Beaufort, see the Bulletin of the Duke University Marine Laboratory.

First Term (Durham Campus)

108L. Developmental and Comparative Anatomy of Vertebrates. Lectures and laboratory on the embryology, anatomy, and evolution of vertebrate organ systems. Not open to students who have had courses previously numbered Zoology 53 or 56. Prerequisite: introductory college biology. One laboratory course. Staff. 9:40-11:00. Laboratory 1:30-5:00. Lecture, 58.130; laboratory, 58.219

151L. Principles of Physiology. An introductory survey. Prerequisites: introductory college biology and a year of chemistry. Laboratory included. One laboratory course. Staff. 9:40-11:20. Laboratory 2:00-5:00 Monday, Wednesday, and Friday. Lecture, 58.113; laboratory, 58.234

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Staff.

353. Research. Hours to be arranged. 2-6 units. Staff.

First Term (Duke Marine Laboratory, Beaufort)

114L. Introduction to Biological Oceanography. Physical, chemical, and biological processes of the oceans, emphasizing special adaptations for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: college biology. One and one-half courses. Staff.

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Staff.

353. Research. Hours to be arranged. 2-6 units. Staff.

Second Term (Durham Campus)

117. Heredity and Society. An introduction to genetics with emphasis on the effects of environment and heredity upon the individual and population. A student may not receive credit for both Zoology 117 and courses formerly numbered 71 or 180. Prerequisite: introductory college biology or consent of the instructor. One course. Ward. 9:45-11:15. 58.113

192T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Staff.

354. Research. Hours to be arranged. 2-6 units. Staff.

Second Term (Duke Marine Laboratory, Beaufort)

192T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Staff.

203L. Marine Ecology. Class discussion on selected papers and field projects; practice in scientific writing and use of computers in ecology. Prerequisites: a course in general zoology, invertebrate zoology, or an appropriate equivalent, and a year of mathematics; some knowledge of statistics will be helpful. One and one-half courses (6 graduate units). Sutherland.

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry (Chemistry 161, 162 or equivalent); statistics (Mathematics 183, or equivalent), or permission of the instructor. (Given at Beaufort.) Includes lectures, laboratory work, and field trips. One and one-half lab courses (6 graduate units). Baier.

250L. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. One and one-half courses (6 graduate units). Forward.

276L. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and in-

vertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. One and one-half courses (6 graduate units). Sullivan.

278L. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. One and one-half courses (6 graduate units). Bookhout.

354. Research. Hours to be arranged. 2-6 units. Stoff.

Third Term (Durham Campus)

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Stoff.

225. Introduction to Field Zoology. The study of animals in their native habitats with emphasis on habitats, collection, identification, life histories, and ecological relationships. Attention will be paid to familiarizing teachers with animals in the field. Field work will be limited to the Piedmont. Practical uses of field studies in teaching will be stressed. Prerequisite: Zoology 211, Zoology for Teachers (formerly Zoology S205), or equivalent. Restricted to students in the MAT or NSF programs. 3 units. Stoff. Daily 1:00-5:00. 58.113; laboratory, 58.115

353. Research. Hours to be arranged. 2-6 units. Stoff.

Third Term (Duke Marine Laboratory, Beaufort)

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Stoff.

202L. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lecture and laboratory. Prerequisite: one course in physiology. One and one-half courses (6 graduate units). Salmon.

212L. Marine Membrane Physiology. Physiology of marine and estuarine organisms with emphasis on cellular transport and electrophysiological processes. The course will include laboratory work on functions, mechanisms, and comparative aspects of ionic and osmotic regulation in marine plants and animals. Prerequisite: permission of instructor. (Also listed as Physiology 212.) Gutknecht and Others.

214L. Biological Oceanography. Composition in time and space of marine biosphere in relation to descriptive marine chemistry, physics, and geology. Some work at sea aboard the research vessel. Prerequisite: chemical oceanography or permission of instructor. One and one-half courses (6 graduate units). Borber.

274L. Marine Invertebrate Zoology. Structures, functions, and habits of invertebrate animals under normal and experimental conditions. Field trips included. Not open to students who have had Zoology 275. Prerequisite: introductory college biology. One and one-half courses (6 graduate units). Stoff.

353. Research. Hours to be arranged. 2-6 units. Stoff.

Information To Accompany Duke University Summer Session Residence Hall Application

Application for room and apartment reservations and all correspondence concerning reservations should be addressed to: Department of Housing Management, House D, Room 101R, Duke Station, Durham, North Carolina 27706.

Room rent is payable in advance. No deductions from grants, scholarships, etc., can be made to pay residence halls fees.

Room and apartment assignments will be made only upon the applicant's admission to the summer session as certified by the Summer Session Office, and upon payment of full rent. Applicants who expect to be in residence for longer than one term of the summer session are urged to make advance reservation for the entire period and thus avoid, to the extent that housing arrangements make it practicable, the necessity of moving from one room to another during the full term of residence.

See page 24 of the Bulletin of the Summer Session for information concerning refund of fees.

Requests for specific roommates will be complied with provided the completed application forms of both applicants indicate mutual agreement and are on hand in the Department of Housing Management at the time of room assignment. If the applicant requests a double room but gives no preference of roommate, the Department of Housing Management will try to assign a roommate.

Residence Hall Rooms—Rates

UNDERGRADUATE AND GRADUATE RESIDENCE HALLS

Few and Edens Quadrangles

Single Room

\$117.50 per term

\$100.00 per term for undergraduate chemistry and physics; also medical mycology

Double Room

\$87.50 per term

\$72.00 per term for undergraduate chemistry and physics; also medical mycology

Rates will be quoted for periods less than one term.

TOWN HOUSE APARTMENTS (GRADUATE STUDENTS) and DUKE-LEASED APARTMENTS (ALL STUDENTS)

\$110.00 per summer session term (three to an apartment)

\$165.00 per summer session term (two to an apartment)

Air-conditioned. Special rates will be quoted for families and for periods less than one term. A \$50.00 residential deposit is required of all persons occupying apartments.

CENTRAL CAMPUS APARTMENTS

At the time of the publication of this Bulletin, fees had not been established for Central Campus Apartments. Information will be provided upon request to the Manager of Apartments and Property, Duke University, Durham, North Carolina 27706.

Refund of Housing Fees. Refunds are made under the following circumstances:

1. When notification for a housing cancellation is received by the Department of Housing Management on or before ten (10) days prior to the first day of scheduled classes of the summer session term, full housing fees will be refunded.
2. When a student withdraws from a summer session term and cancels a housing assignment during the first five (5) days of classes, refund will be made for the total amount paid for the term, less \$28.00 (single room) or \$21.00 (double room) in the case of residence hall cancellation and \$22.00 (three to an apartment) or \$33.00 (two to an apartment) in the case of Town House and Duke Manor Apartments cancellation.
3. When a student withdraws from a summer session term and cancels a housing assignment between the fifth day and the tenth day of classes, refund will be made for the total amount paid for the term, less \$54.00 (single room) or \$40.00 (double room) in the case of a residence hall cancellation and \$44.00 (three to an apartment) or \$66.00 (two to an apartment) in the case of a Town House or Duke Manor Apartment cancellation.
4. If a request for a cancellation of a housing assignment for a summer session term is made for reasons other than withdrawal from summer session on or after the eleventh day of classes, no refund will be made.
5. If a student withdraws from a summer session term after the eleventh day of classes, 50 percent of the unused portion of the housing fee will be refunded.

Duke University Summer Session: Application for Housing

Please Print

Male
Female
Graduate
Undergraduate

Name _____

Mailing Address _____

Permanent Address _____

Present Position _____ City _____

Anticipated courses of study: (1) _____
(2) _____

Accommodations Desired

Room: Single _____ Double _____

Town House Apartments: * _____ Family _____ No. Persons _____

Unaccompanied Students; _____
(Graduates and families Only)

Duke-leased Apartments: * _____ Family _____ No. Persons _____

Unaccompanied Students; _____
(All students and families)

Name of roommate(s) preferred: _____

Number of terms enrolled _____ Date of arrival at Duke _____

Enclosed is check/money order payable to Duke University in amount of \$ _____

(Total payment required with application. No assignments will be made until full remittance is received. Please ensure that your remittance covers the specific number of weeks you will be in residence).

* A \$50 residential deposit is required of all persons assigned to an apartment.

Mail completed application and check to:
Department of Housing Management
Duke University, Duke Station
Durham, North Carolina 27706

NOTE: You will be notified of your assignment and the date of occupancy as early as possible, but within three weeks of the desired date of arrival at Duke.

Directions to Summer Session Applicants

All applicants for summer session courses who are not now in residence at Duke University must fill out accurately and in detail the form below and return it to the Director of the Summer Session. Preference in enrollment will be given to persons returning the form promptly, but a place in a particular course cannot be assured until all fees are paid. Undergraduates or graduates who are enrolled in a university or college other than Duke University and who are seeking to transfer summer session credits to the college in which they are matriculated should request a course approval form to be certified by their dean or registrar. Graduate students are reminded that credit earned as an unclassified graduate student cannot be applied toward an advanced degree at Duke University. Persons applying for admission to the Graduate School of Duke University should write the Dean of the Graduate School for the necessary forms in addition to completing the form on page 75.

Undergraduates, both men and women, are required to live in the residence halls unless they are married or living with parents or relatives or have received permission to reside off campus for the previous or subsequent academic year. Any exception must be approved in advance by the Dean of Students.

MAP OF DUKE UNIVERSITY

East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
D	Union Building
E	Faculty Apartments
F	Art Museum, Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert-Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building
	School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T.
	Clinical Research
J	Duke Hospital
K	Sociology, Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle
O	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Kilgo Quadrangle
T	Union Building
U	Flowers Building
	Page Auditorium
V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Labora
Z	Biological Sciences
AA	Plant Environment
	Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Resear
	Buildings
GG	Nanaline H. Duke Med
	Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House
KK	School of Nursing
LL	Hanes House Annex
	Pickens Rehabilitation
	Center
MM	Graduate Center
NN	Alumni House
OO	Commonwealth Studie
	Center
PP	Personnel Office
QQ	International House
RR	Personnel Office
SS	Education Improvement
	Program
TT	A Better Chance Prog
	Center
UU	International Studies
VV	Campus Stores Offic
	Office of Institutional
WW	Advancement
	Information Services
	Visitors Bureau
XX	Admissions Office
YY	Edens Quadrangle
ZZ	Wade Stadium



Application for Enrollment in the Duke University Summer Session

Mr., Mrs., Miss _____ (Please Print)

Street Address, Rural Route, or P. O. Box _____

Post Office _____ State _____ Zip Code _____

Social Security No. _____

Please register me in the following courses listed in the Bulletin of the Summer Session.

Department	No. of Course	Title of Course

Name and address of high school from which you graduated _____

Have you attended a college? Yes _____ No _____

Name and address of college _____

Highest degree held _____

Are you a candidate for a degree? Yes _____ No _____

If yes, for which degree? _____

Check the one below which indicates your present University status. (Do not indicate a status in a Duke University School or College unless you have already been admitted to that School or College)

Undergraduate credits

Graduate credits

Trinity College of Arts and Sciences
School of Nursing
School of Engineering
Special or unclassified
Credits for transfer

Graduate School
Divinity School
School of Forestry
Special or unclassified
Credits for transfer

Are you applying for admission to the Graduate School? _____

Are you at present a college student? _____ If so, where? _____

What class? _____

See Reverse

Are you a full-time teacher? _____

If so, give name and address of school _____

Teaching Position:

Elementary: _____

Secondary: _____

Administrator: _____

Supervisor: _____

Have you attended previous Summer Sessions at Duke? Yes _____

Years _____ No _____

Do you wish credit certified to some agency or school? Yes: _____ No: _____

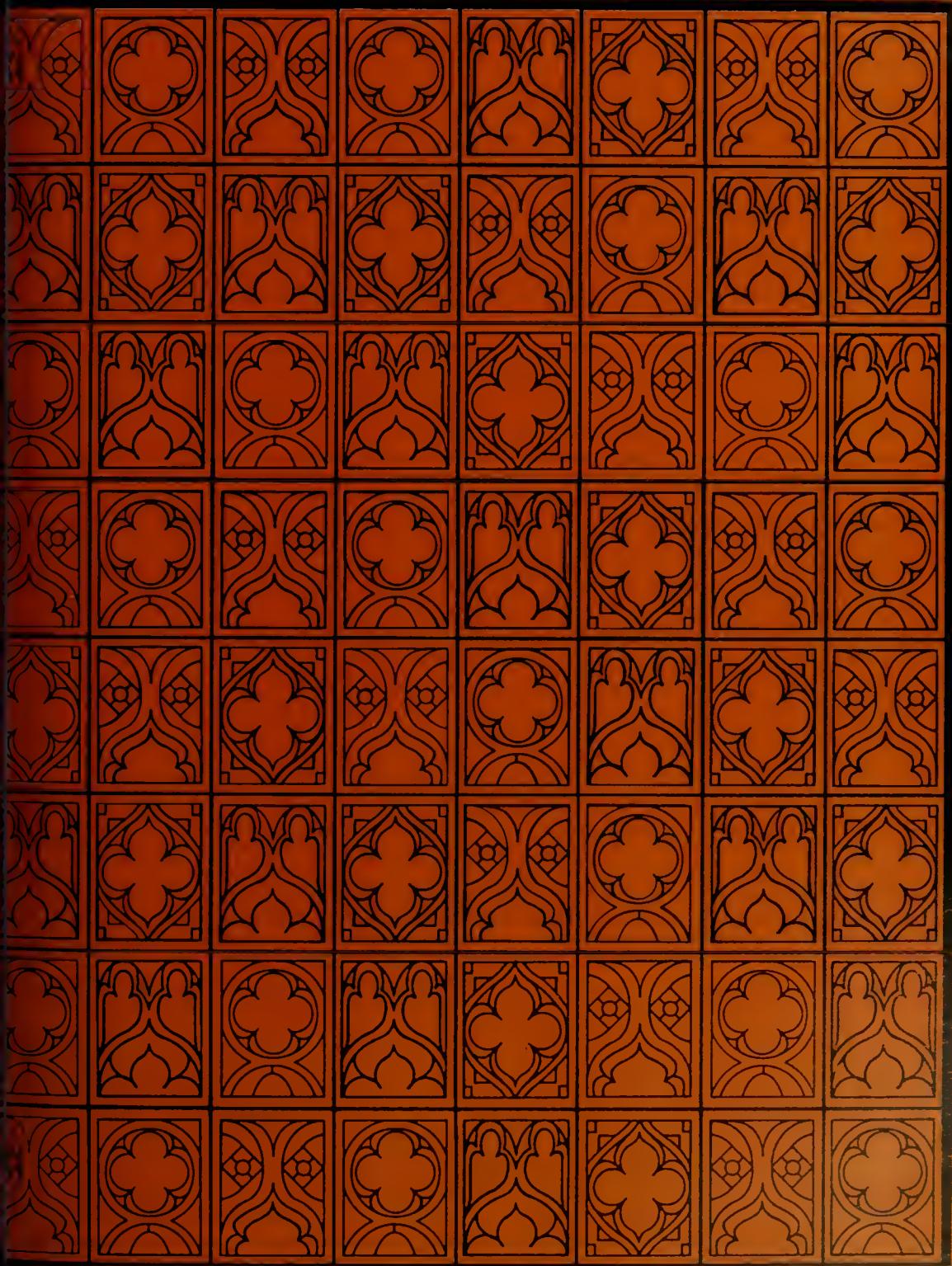
If yes, please give exact name and address of agency or school. _____

REFERENCE DEPARTMENT
WILLIAM R. PERLMAN LIBRARY
DUKE UNIVERSITY
DURHAM, N. C.



Bulletin of Duke University 1974-1975

The Graduate School

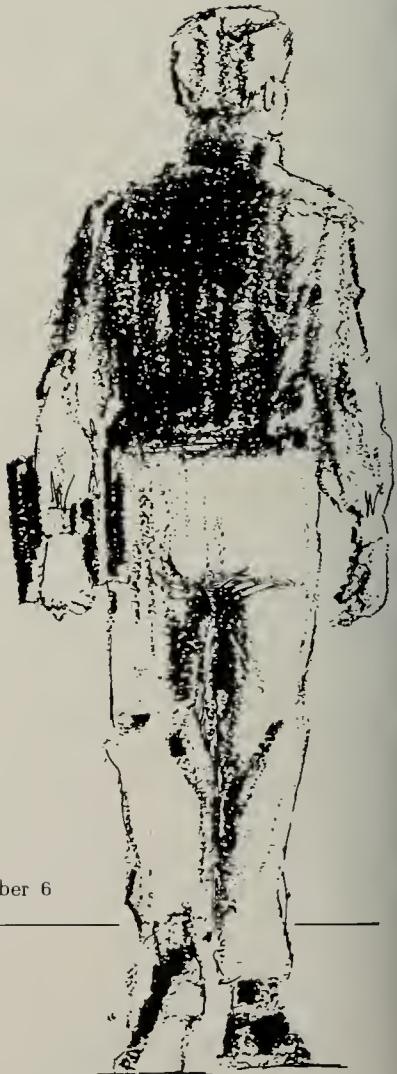


Bulletin of Duke University

The Graduate School

1974-1975

Durham, North Carolina



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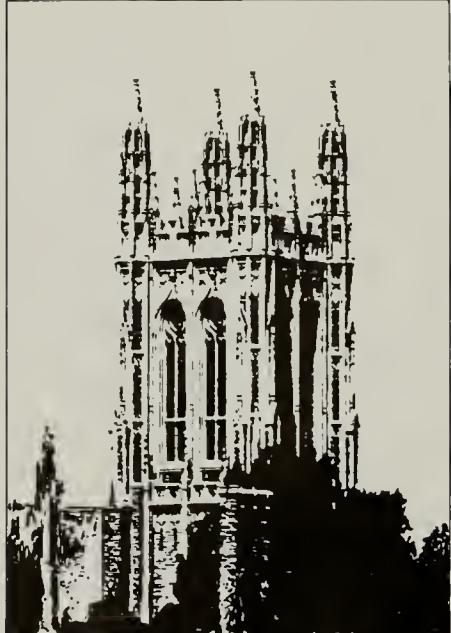
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Contents

Introduction	7
Should I Go to Graduate School?	8
How Should a Graduate School be Chosen?	8
How Long Will It Take?	11
How Can I Pay for It?	12
The Duke University Graduate School	17
General Regulations Governing Graduate Studies	19
Admission	19
Earning the Degrees	22
The Language Requirement	23
Other Requirements	23
Financial Regulations	24
Calendar of the Graduate School	25
Advanced Degree Programs at Duke (with an abbreviated list of course offerings, 1974-75)	27



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To the Prospective Graduate Student at Duke University

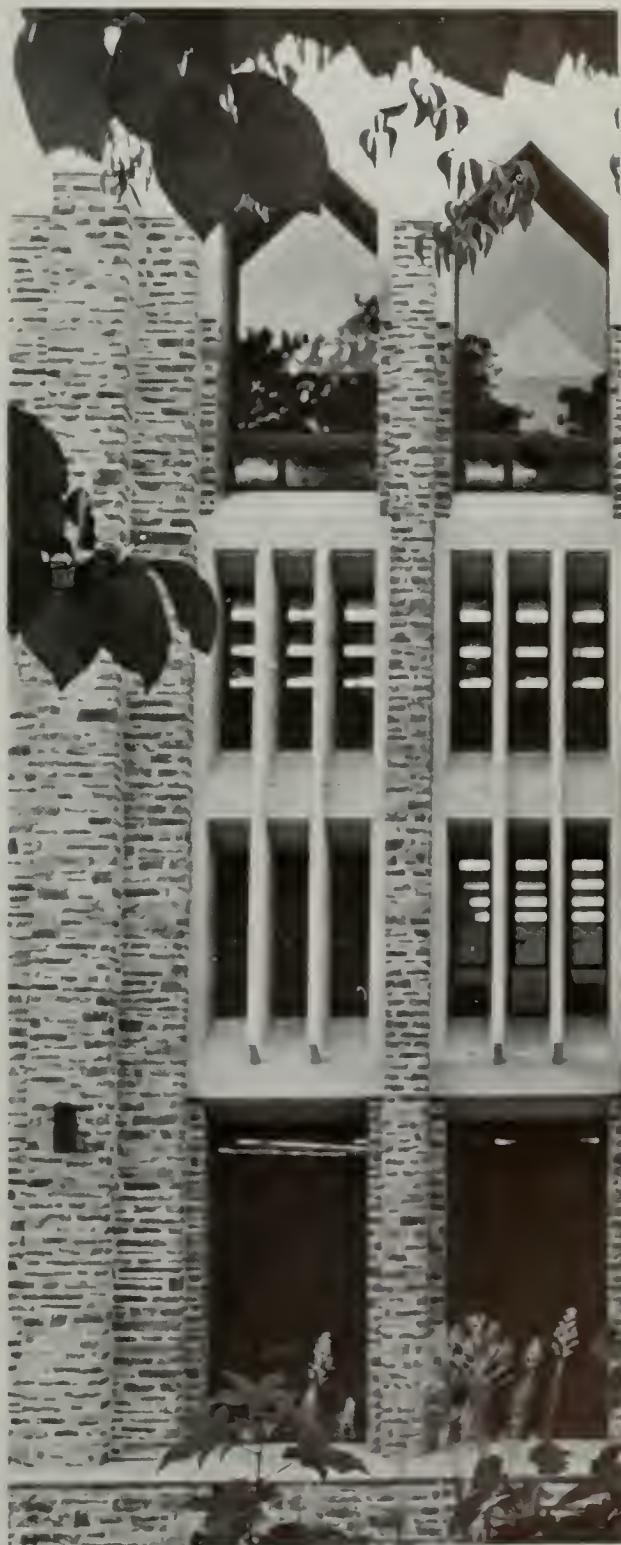
Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report:

The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise in futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.

Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his "original" research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education, Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.

John C. McKinney
John C. McKinney
Dean of the Graduate School







Writing in the 1920s, the philosopher and man of science Alfred North Whitehead described the goal of higher education in these terms: "The task of a University is the creation of the future." It is only ninety years since the founding of the first formally organized graduate school in the United States, but it has become most evident that graduate schools, through their training of teachers, researchers, industrial specialists, scientists, and government advisers, play one of the most vital roles in "the creation of the future."

Ideally, a graduate school is a community of scholars—apprentice, initiate, and master—engaged in imparting and extending the realm of man's knowledge in the arts and sciences. A select group of students is admitted each year to undergo the rigorous discipline of an advanced degree program, the successful among them to emerge as scholars of promise. To enter upon graduate education today is to accept a real challenge, but the decision should not be made lightly or casually. The work toward a doctorate involves several years of tireless effort and possible sacrifice, and the material rewards may be less certain or less bountiful than in some alternative occupation. Pursued with determination, however, graduate education may be the doorway to a stimulating, creative, and meaningful life—a life which few persons who have chosen it would exchange if they had the opportunity of reliving their student years.

Introduction

The student who is contemplating this challenge usually has many questions in mind; the following pages are an attempt to answer some of them. Many of the comments are applicable to programs at any university, although emphasis is placed here on the graduate programs at Duke University.

Should I Go to Graduate School?

This question can ultimately be answered only by the questioner himself. The decision to work toward an advanced degree must be a personal commitment born of a real willingness to devote oneself to many months or possibly years of hard intellectual work just at the age when one may be impatient for financial independence and freedom from academic discipline. Graduate education requires all the energy, enthusiasm, and self-discipline at one's disposal; to enter upon it half-heartedly is to invite discouragement or failure.

An equally important requisite for success in graduate study is the possession of a keen and disciplined intellect. Of this it can only be said that "the proof of the pudding is in the eating." A good undergraduate record may or may not be adequate evidence of ability. Many a student with an excellent undergraduate record has been unsuccessful in graduate study, because his undergraduate training stressed an ability to marshal facts and to articulate these facts rather than real understanding and analysis of material. On the other hand, many distinguished scholars had undistinguished undergraduate records. It may be of some comfort to remember that Einstein had difficulty in mastering simple mathematics (although one should be certain that he is another Einstein before using this fact as an easy excuse). In gaining admission to a graduate school, the undergraduate record is of course an important element, but usually some margin is left to allow for the student who develops a serious academic interest only at a late stage. The student himself is often better able to judge whether his grade record is a true gauge of his ability or represents an under-par performance.

If a student feels he has both the ability and a strong desire to accept the challenge, he should not let other obstacles influence his decision unduly. About two-thirds of current students enrolled in Ph.D. programs in American universities have sufficient financial support from universities, industries, or foundations to meet the minimum cost, and most universities have loan provisions to help the student without adequate resources. Today about 60 percent of graduate students are married, and a majority of student's spouses work part or full time during the student's periods of residence. Indeed, many spouses pursue an advanced program concurrently.

There is no certain way of knowing in advance whether one will be successful or happy in graduate school; in this regard it differs little from any other career path one may choose to follow. It is quite likely, however, that if one has both the motivation and the ability and does not try it, there will be regrets in later years. Although this must be an individual choice, superior intellectual ability is a scarce human resource, and its encouragement and utilization are areas of national as well as personal concern.

How Should a Graduate School Be Chosen?

Over two hundred and fifty universities today offer work leading to the Ph.D. degree. Among these are about sixty institutions which grant only two or three such degrees a year in all fields combined. At the other end of the scale are about fifty universities which account for nearly 70 percent of all doctorates granted in this country. Duke University is among these latter, as are most of the major institutions which offer work of quality ranging across a breadth of academic disciplines. But even if one can narrow the field to about fifty major institutions, how does one select among these, and what factors should affect one's final choice? A few key factors are discussed briefly below.

Size. Size is not an infallible guide to the quality of a graduate school. There are a number of poor graduate



schools of exceedingly large size, and a number of extremely good small ones. There are advantages, however, in attending a university which has attained a certain level of size, although it is difficult to provide a magic number to use as a yardstick. It is simpler to mention a few of the disadvantages of too many or too few students.

An extremely large graduate school—and there are a few today which have between six and twelve thousand enrolled—is a far cry from the ideal of a small number of superior students working closely in intellectual pursuits with a few esteemed scholars. Classes of fifty to a hundred students, inaccessibility of senior faculty, shortage of library materials and facilities, only a nodding acquaintance with fellow students—these are only a few of the possible drawbacks. A very able student may develop well even in such an atmosphere of mass production, but this situation is hardly the ideal.

An extremely small graduate school also has its disadvantages. Most of the classes are likely to be mixed undergraduate-graduate classes, where a student is not surrounded by many other good students who will help to sharpen his powers and create an at-

mosphere conducive to learning. Also, facilities are often limited, and the faculty is likely to be primarily composed of undergraduate instructors. A university must be willing to commit a significant portion of its resources to develop a graduate program of high quality, and this often is not the case in an extremely small graduate school.

More important than the size of the entire graduate school is the size of the particular departmental program in which a student is interested. An optimum doctoral program will have an enrollment of perhaps thirty to one hundred students, admitting fifteen to forty new students each year, and turning out perhaps three to ten Ph.D.s per year. Information on enrollment or degrees conferred is usually available in university catalogues or government publications on higher education, and a prospective student may find it useful to compare enrollments in various institutions before choosing a school.

Duke University is firmly committed to programs of moderate size where the interests of the student are paramount. Total enrollment in the Graduate School is about 1,900 students. Between four and five hundred new students are admitted each year from

approximately four thousand applications. Only four departments have more than eighty students; seventeen departments have enrollments that fall within the optimum range suggested in the preceding paragraph.

Quality. Not only do universities differ considerably in their reputation for quality, but there are marked differences among departments within any university. Harvard, for example, is a great university because it has many reputable departments, not because it is best in every category. On the contrary, many excellent universities have a few weak departments in which a student would fare less well than he might in an excellent department in a less esteemed institution. Therefore, the student should not be guided solely by the reputation of a university as a whole, but should inquire more specifically about the area in which he wishes to specialize.

Since judging the quality of a graduate program is necessarily subjective, no two people are likely to be in complete agreement. The prospective student would do well to talk with his professors in his undergraduate college, particularly those who have themselves achieved some reputation in the world of scholarship. As witnessed by their own continuing writing and research, they are more likely to have reliable information on the merits of various graduate programs. Similarly, the younger faculty member who is only four or five years out of graduate school may have more recent acquaintance with his and other schools.

Another yardstick to quality, albeit an imperfect one, may be the occasional questionnaires asking other educators to rank various graduate departments. In a recent American Council on Education report, of the 23 Duke graduate programs evaluated, 13 were rated as "distinguished" or "strong," eight were rated as "good," and two were rated as "adequate plus."

None of these guides is adequate in itself, but taken in conjunction with individual advice and recommendations they may help the student in his selection. An extremely good student can obtain a good graduate education in a number of universities, but in such





an important choice it pays to be as well informed as possible.

The best procedure is to take many factors into account in choosing where to apply for admission, and then make application at the three or four schools one would most like to attend. (Applying at fifteen universities is merely a waste of an applicant's and the universities' time.) It is wisest not to make a final selection solely on the basis of financial aid available, on the advice of a single friend or adviser, or on a university's past prestige. One should get as much current information as one can. Write to the graduate school or the departmental director of graduate studies if further information is desired; visit the university in person, if possible; and carefully weigh the advice of distinguished faculty members of one's undergraduate college.

How Long Will It Take?

One of the primary questions in the mind of every student considering graduate study is "how long will it take?" This is not an easy question, however, for the answer depends partly on the requirements of the student's program, partly on the student himself, and partly on the attitude in the graduate school and the department in which he is studying.

The student's level of preparation before entering graduate school has a direct bearing on the speed with which he can progress toward a degree. One who enters with proficiency in one or more foreign languages and a good foundation in his chosen subject area may well be able to finish within the minimum time limits. On the other hand, the less well prepared student may find that one and a half to two years are the minimum for the A.M. degree, and four to five years for the Ph.D. degree (although wise use of the summers may reduce this time somewhat). The total time may also be lengthened if the student must work during part of his period of residence. (More on this subject will be found below, under "How Can I Pay for It?")

The attitude of the graduate school and its various departments will also affect the time needed to complete the degree. During the last decade the

average time elapsing between entering graduate school and receiving the doctorate in American universities has been about ten years. A study of experience at Duke during the early 1950s indicated that the average doctorate in the humanities required a little over seven years, nearly six years in the social sciences, and slightly over four years in the sciences. Over the last few years, however, Duke University has been among the forerunners in reducing the time needed to obtain the Ph.D. without any sacrifice in quality. This effort has taken the form of trying to eliminate the unnecessary delays, particularly those due to financial burdens on the student. Duke ranks among the leading institutions in the country today in terms of financial aid per student from university sources. Moreover, much of this aid is in the form of fellowships and scholarships which do not require burdensome services in return. The large public institutions are often more restricted to awards which require substantial teaching, research, or other duties, thus reducing the speed with which a student can complete his resident course work. A student will be wise to inquire to what extent his progress toward a degree may be delayed by the work entailed in certain awards. If, for example, an assistantship lengthens unduly the time necessary to obtain a degree, even a smaller fellowship may be preferable.

Another way in which Duke encourages deliberate speed toward fulfilling degree requirements is through its tuition charges. Many graduate schools charge tuition for three full years in a doctoral program. In 1958 Duke adopted the policy of charging full tuition and fees only up to the time the doctoral student passes his preliminary examination. (This examination is taken upon completion of all course and language requirements, normally at the end of the second year, before the student is formally admitted to candidacy for the Ph.D.) After "prelims," tuition charges are substantially reduced. In making his choice of a graduate school, a prospective student should inquire about the fees for a full doctoral program, not merely the charges for the first year. The tuition and fee system at Duke has worked to encourage both the student

and his department to arrange for preliminary examinations to be taken before the beginning of the third year. Some years ago fewer than half of the doctoral students at Duke took this examination before the beginning of the third year; today over 90 percent are doing so. This plan, aided by scholarship and fellowship aid, gives the graduate student at Duke a marked advantage over his counterparts in many other graduate schools in acquiring his degree in the minimum amount of time.

How long will it take to obtain an advanced degree, therefore, depends on many factors, but the policy of the Duke Graduate School is to keep time at a minimum and consistent with continuing quality in its graduate program.

How Can I Pay For It?

The typical entering graduate student, after completing his four-year undergraduate program, may not be able to continue with support from his family or from part-time earnings. All graduate schools, in order to minimize financial barriers for superior students, have at least modest funds at their disposal in the form of scholarships, fellowships, or assistantships. Few private universities have sufficient funds to aid more than half of their graduate students and often make total awards which are considerably greater than their entire tuition income from such students.

In recent years at Duke about two-thirds of all full-time students have held an award of some type; about one-third of these were aided by Duke funds and the other two-thirds by funds from other sources.

The student who seeks financial aid from the graduate school of his choice should be certain that he files his request for admission and award at a sufficiently early date. An application should be completed not later than February 1 of the year in which September admission is sought. At Duke, the student's application, including transcripts of his previous college work and letters of recommendation, is processed by the Graduate School and forwarded to the department in which he wishes to pursue advanced work. The graduate faculty—or admissions committee—in



the department reviews all applications and then makes its recommendation to the Dean for announcement in late March. The most outstanding applicants are then offered awards; the next in order of rank are placed on an alternate list for awards. Other students whom we want to attend are offered only admission to the Graduate School. Because of multiple applications by students, a fraction of the awards offered by any graduate school are turned down by students who finally decide to go elsewhere. Alternates on the award list are immediately notified, and the process continues until the desired number of awards has been made.

The determining factors in the student's position in these rankings are the letters of recommendation, the undergraduate record, and (if required) pre-entrance test scores on the Graduate Record Examination. The quality of some capable applicants is not always evident according to these criteria, although they may turn out to be excellent students after admission. Often part-time jobs, extracurricular activities, lack of seriousness of purpose at

an early age, or similar factors make a student's undergraduate record a poor gauge of his capabilities. The Graduate School, however, must judge as best it can from limited information, admittedly making occasional errors in judgment. Letters of recommendation usually weigh heavily when the writer is a scholar held in high esteem by the faculty of the school to which application is made.

Entering graduate school for the first year without an award will not prejudice one's chances for a later award. In the spring of the first year the graduate faculty reviews the progress of all current award holders and weighs the applications of others. Awards for the second and third years are made almost entirely as a result of the student's record in the graduate program. Thus, it is often a wiser course in the long run to enter a good graduate school without an initial award than to go to a less attractive school with modest financial aid.

Awards to entering students at Duke are in the form of fellowships, scholarships, and assistantships.

James B. Duke Graduate Fellowships are provided through a special endowment of the Duke Endowment. Fellows are chosen from nominations made by the departments. Only outstanding applicants who are beginning graduate study and seeking the Ph.D. degree are considered. These nominations are made in late February and are judged in a competition which includes all departments granting the Ph.D. degree. These fellowships provide for payment of tuition for full registration and stipend of \$290 per month for the full calendar year during the first two years and for the academic year during the third (final) year. The award requires no service beyond that which is required of all students in a given department as a part of their training and is renewable each year upon satisfactory progress. The total value of a James B. Duke Fellowship over the full three years of tenure is approximately \$15,000.

Graduate Fellowships range in value from about \$2,400 for the academic year to \$5,150 for the calendar year and are made on a year-to-year basis. They are awarded upon recommendation by each department. No service is required as a prerequisite for accepting a fellowship, but all fellowship holders are expected to maintain full-time registration.

University funds have been made available to stimulate the admission and matriculation of well-qualified black students in the Graduate School. These funds are to supply fellowship support to six students during the next academic year.

Graduate Scholarships provide for payment of tuition or partial tuition. Full tuition scholarships are valued at \$2,340 for the academic year. Scholarships are awarded upon recommendation of each department.

Graduate Assistantships range in value to \$4,530 for the academic year. Assistantships normally require services of the student up to twelve hours a week and permit the student to register for a four-fifths course load. Assistantships are most common in the science departments, where the student often provides laboratory assistance to

various members of the faculty. Most graduate assistants remain in residence for at least one of the summer sessions during their first two years, carrying sufficient research or course credit so that they can complete their residence requirement of 60 units within two years. In this way, the normal progress toward a degree is not impeded by the reduced load during the fall and spring semesters. Departmental research funds are often available to provide financial assistance during the summer.

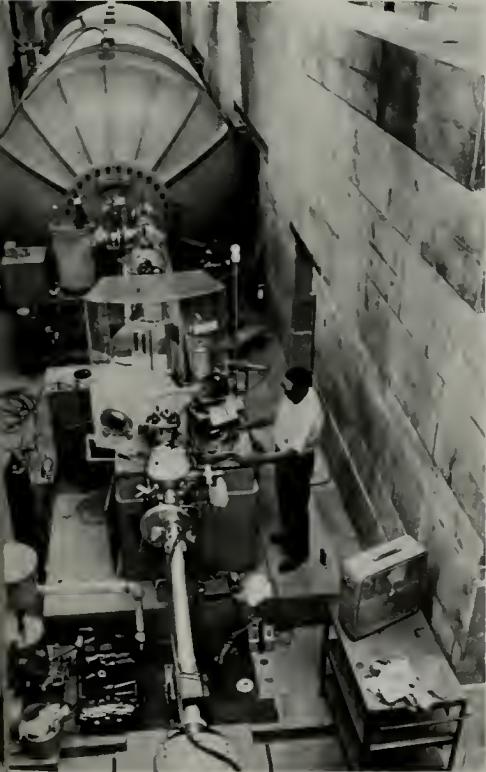
Other graduate fellowships are available from foundations, industry, or the government. Among those at the University's disposal are James B. Duke Commonwealth fellowships for students in political science, economics, and history, concentrating their studies on the British Commonwealth; Kearns fellowships in religion; Shell fellowships in chemistry, physics, political science, and mechanical engineering; Donner fellowships for Canadian studies for students in history, sociology, political science, and economics; Medieval and Renaissance Studies fellowships; and Cokesbury awards for the preparation for college teaching. In 1973-1974 six students held Foreign Language Fellowships awarded by Duke University under Title VI of the National Defense Education Act in Southeast Asia Area Studies. A number of other traineeships and assistantships are available in the biological, physical, and social sciences under grants from National Institutes of Health, National Institutes of Mental Health, National Science Foundation, National Aeronautics and Space Administration, Atomic Energy Commission, research agencies in the Department of Defense, and other governmental agencies.

Loans may be obtained through the National Direct Student Loan Fund and through the Federally Guaranteed Student Loan Program. In addition the University provides loans from funds set aside for this purpose. A deferred tuition program is also available. In this program repayment, subsequent to graduation, is based partially on income. Particular eligibility requirements must be met for each program. All require that need criteria be met, but funds under favorable terms are expected to

be available to meet legitimate requests. Further information may be obtained from the Graduate School Office.

It is difficult to estimate a student's financial needs during the years of graduate study because of individual tastes and habits. One can predict with some accuracy, however, the three major items of expense at Duke: tuition, \$2,580 for a full program for each of the first two years, usually \$516 for the Ph.D. dissertation year; room rent, \$393-\$527 each year in graduate dormitories; and board, approximately \$750-\$800 in graduate dining halls. Students holding awards are usually paid in nine equal installments beginning in late September, and tuition and room fees may be deducted monthly on a pro rata basis.

The costs of graduate education are high, but Duke University attempts to allocate its funds so that the superior student is able to finish his work for a degree in the normal length of time regardless of his personal financial resources. This is a contribution to the community of scholarship which the University is glad to bear.







Duke University Graduate School

In surveying the progress made in the first seven years after the founding of Duke University, its first President, William Preston Few, wrote that he wanted "to see the Graduate School made strong because it will best and most quickly insure our attaining and maintaining a place of real leadership in the educational world." President Few believed that "more than anything else here our Graduate School will determine the sort of University we are to build and its standing in the educational world." These opinions have continued to prevail to the present day, with emphasis upon the interdependence of teaching and research as the necessary components of scholarship.

Over five hundred members of the graduate faculty teach the approximately six hundred courses and seminars offered in the Graduate School, and supervise thesis and dissertation research. Many of the major universities of the world have helped to train this faculty; approximately 90 percent of the graduate staff hold degrees from the forty-six institutions which make up the Association of Graduate Schools within the Association of American Universities. By place of birth they represent almost every state in the Union and almost two dozen foreign countries.

The nineteen hundred graduate students currently enrolled represent a similar diversity in background. Approximately 41 percent of the students recently completing doctoral degrees are

from undergraduate colleges in the Southeast, 16 percent from the Middle Atlantic states, 12 percent from New England, 11 percent from the Central states, 7 percent from the Southwest, 2 percent from the Northwest, 1 percent from the Far West, and 10 percent from foreign countries. The old maxim that a university is only as good as its faculty might be amended by adding "and no better than its student body." No professor can give his wisdom to a student, and no student can take his understanding to another. This must be a reciprocal process between professor and student. The groundwork for learning may be laid in privacy—indeed a certain amount of private study and research is absolutely essential—but the vital stimulus to the learning process comes from one's contact with the minds of other men with similar or related interests. This is precisely why graduate schools are highly selective in their admissions policy, and it is one of the important reasons for their willingness to offer attractive fellowship awards to outstanding students. The superior student is a valuable catalyst both for his fellow students and for his faculty, and is prized as such.

Faculty and students comprise the essential human factors in education, but their joint endeavor cannot prosper without adequate research and library facilities. Duke University is particularly fortunate in regard to research facilities, for the physics, botany, zoology, chemistry, psychology, sociology, engineering, and biochemistry laboratories have been built entirely within recent years, and modernization and expansion have occurred in other scientific areas. The University shares a magnificent computing facility with the University of North Carolina and North Carolina State University. The Triangle Universities Computation Center is among the largest research-oriented computer facilities in the world. It is also the University's pride that it has one of the finest research libraries, the twentieth largest university library in the nation today, second in the South, and first in the Southeast. In number of volumes, breadth of coverage, serials, and documents, it is a much more adequate library than that available in many graduate schools with enroll-

ment two or three times as large. To the student in the arts, humanities, and social sciences, for whom the library is the bloodstream of scholarship, this is an immeasurable asset.

Among the many special features of the Graduate School a few important examples may be mentioned. For students in the biological sciences, the facilities of the Duke Marine Laboratory at Beaufort, North Carolina, are available for course work and research. The Laboratory has research buildings, classrooms, motor vessels (including the 118-foot oceanographic ship, the *R/V Eastword*), and living quarters, which make it one of the best research centers in marine biology in the country. Closer to home are the 8,000 acres of the Duke Forest, managed by the School of Forestry, ideal for research on timber growth, soils, and related topics. A large phytotron has recently been completed.

Duke is also fortunate in having excellent Medical, Law, Engineering, Forestry, and Divinity Schools on its main campus, thus making additional facilities available for course or research work related to the graduate curricula in the arts and sciences. A three-term summer session and the availability of courses at the nearby University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh under a cooperative arrangement offer other opportunities to the graduate student.

No description of programs can begin to give the prospective student the full flavor of graduate study in a particular institution. A visit to the universities in which one is particularly interested may be helpful in giving one a better picture. If this should be practical, the Duke Graduate School offers a warm invitation to prospective students to come to the campus during the year to discuss their possible application and admission. The visitor will find at Duke most of the facilities that one could hope for in the largest of institutions, and yet the University has been fortunate in avoiding many of the evils inevitable with mass education. Despite the total University enrollment of approximately 8,500, Duke has retained the sense of com-

munity that one usually associates with a smaller liberal arts college. And in an age when current architectural whim often adds yet one more variant style to an already assorted array of buildings, Duke has built with foresight and design a campus of unusual beauty. This, too, is an important part of the fabric of education, creating an environment conducive to learning.

Special Programs

Special and cooperative programs at Duke include:

- Center for the Study of Aging and Human Development
- Canadian Studies Program
- Center for Commonwealth Studies
- Program in Comparative Studies on Southern Asia
- Cooperative Program in Teacher Education (Secondary M.A.T. Degree)
- Cooperative Program (with the University of North Carolina at Chapel Hill) in Russian and East European History
- Center for Demographic Studies
- Duke Environmental Center
- University Program in Genetics
- Program in the History of Social Sciences
- Hispanic Studies Program
- Materials-Fields-Mechanics Research Program
- Medical Scientist Training Program
- Medical Historian Training Program
- Program in Medieval and Renaissance Studies
- Predoctoral Training Program in Sciences Related to the Nervous System
- Oak Ridge Institute of Nuclear Studies
- Organization for Tropical Studies
- Institute for Public Policy Sciences
- Social Systems Simulation Program
- Center for Southern Studies (including the Oral History Project)
- Stochastic Systems Program (with the University of North Carolina at Chapel Hill)

Further information may be obtained by writing the individual program, c/o Duke University, Durham, North Carolina 27706 or by writing the Graduate School Office.

General Regulations Governing Graduate Studies

The official detailed *Bulletin* of the Graduate School, published in February of each year, gives an account of regulations concerning graduate work at Duke University and a full description of course content. The following pages are a summary of these materials for 1974-75 and should provide sufficient information for the prospective student. The *Bulletin* is normally mailed to each student who is admitted to the Graduate School in the late spring of the year of matriculation so that he may plan his course program for the first year. Copies may be obtained in February, however, by writing to the Graduate School Office, Duke University, Durham, N.C. 27706.

Admission

All applicants will be considered without regard to race, color, religion, sex, or national origin.

Admission is required of (1) all students who intend to pursue study toward a degree offered by the Graduate School, (2) all other students who desire credit for whatever purpose for graduate courses—except students who register as Special Students in the Summer Session. Students who have discontinued a program of study after earning a master's degree here must by letter request permission of the Dean to undertake a doctoral program.

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. The student's undergraduate program should be well rounded and of such quality as to give positive evidence of capacity for graduate study. Ordinarily the student should have majored in the area of intended graduate study. Many departments (see the section on Advanced Degree Programs at Duke) list specific prerequisites. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language tests in French, German, Russian, and Spanish are offered to under-

graduate and graduate students at many centers on nationally uniform dates (see the section on Language Requirement).

Procedures. A student seeking admission to the Graduate School should request the Dean of the Graduate School to send an application blank. This should be filled out completely and returned promptly. Each application must be accompanied by a nonrefundable fee of \$15.00 in check or money order payable to Duke University. In addition the student should provide the following supporting documents: (1) two copies of the official transcript from each college, university, or seminary attended sent to the Dean directly by the institution; (2) as soon as possible, two supplementary transcripts showing completion of work which was in progress when the earlier transcript was made; (3) three letters of recommendation, written on the forms provided, by persons best qualified to judge the applicant as a prospective graduate student, and mailed directly to the Dean; (4) scores on the Graduate Record Examination Aptitude Tests for all departments except education; and (5) scores on the Graduate Record Examination Advanced Test for biochemistry, botany, chemistry, English, mathematics, microbiology, pathology, physics, physiology, psychology, Romance languages, sociology, and zoology.

Applicants to the Graduate School of Business Administration and the Department of Health Administration are required to take the Admission Test for Graduate Study in Business, administered by the Educational Testing Service.

Students applying for financial aid in all departments should take the Graduate Record Examination no later than the October testing in order to meet the February 1 deadline. Information on times and places of the Graduate Record Examinations can be provided at the applicant's college or by the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704.

Fully qualified students from outside the United States are welcome to take courses in the Graduate School

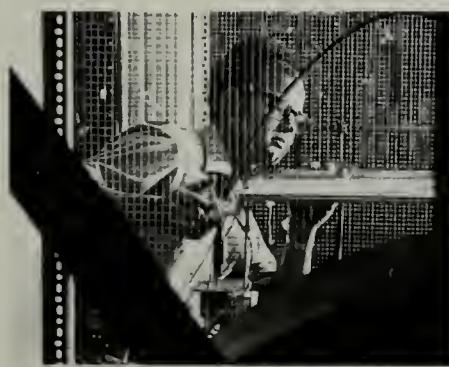
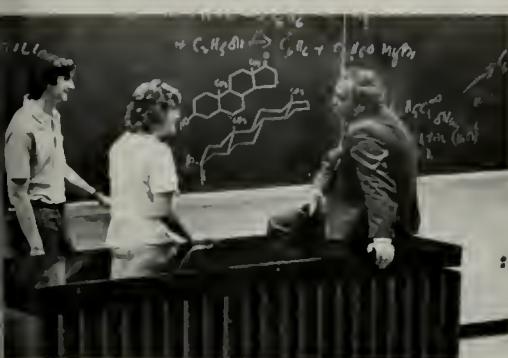
and, in many instances, to study toward a degree. In applying for admission the foreign student must, in addition to the information required of all students, submit with application material (1) if the student's native language is not English, certification of English proficiency demonstrated by scores from the Test of English as a Foreign Language (TOEFL), administered through The Educational Testing Service in Princeton, New Jersey, or, if the student is in the United States, a statement of his English proficiency written by a professor of English at the student's university; (2) a statement showing financial arrangements for the proposed term at Duke (estimated costs per academic year are \$4,400); and (3) a statement by a qualified physician describing any emotional or physical illness the applicant has had during the previous five years. A foreign student must meet all these requirements before the Graduate School will make any offer of admission.

All foreign students whose native language is not English will be examined during their first registration period for competence in the use of oral and written English. Until competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack the necessary competence will be required to enroll in the non-credit course called English for Foreign Students and to reduce their course or research program by 3 units.

A student who does not successfully complete this course during the first year of residency will not be permitted to continue graduate work at Duke University. Passing this examination or the course, if it is required, will not meet degree requirements for a foreign language.

When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is not complete until the student returns the acceptance form.

Applicants who are admitted will be offered full admission, provisional admission, or nondegree admission. Provisional admission is offered to students who appear to warrant admission but do not fully comply with



admission requirements. It is offered for a trial period of one semester or 12 units of course work. Nondegree admission is offered to students who (1) have no intention of taking an advanced degree at Duke University but wish to take courses for accreditation for transfer to other institutions, or for other purposes, or (2) do not fully meet admission requirements but wish to further their academic interests. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission; graduate credit earned under nondegree status may not be applied toward an advanced degree.

It is the applicant's responsibility to make certain that the Graduate School Office has received all required material before the specified deadlines. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted two weeks before the closing dates listed below.

We encourage all candidates to apply by February 1. Anyone whose folder is not complete before that date will face the possibility that departmental enrollment will have been filled. While the Graduate School Office will process later applications, it cannot guarantee full consideration of a folder for any department after April 15.

Fall semester, admission and award	February 1
Fall semester, admission only	July 15
Spring semester, admission only	December 1
Summer session, 1975* first term	April 15
Summer session, 1975* second term	May 15
Summer session, 1975* third term	June 15

*Students seeking admission to the Graduate School for study in the summer session should apply to the Dean of the Graduate School and to the Director of the Summer Session.

Earning the Degrees

Duke University offers graduate programs leading to the specified advanced degrees in the following fields:

Anatomy, A.M., Ph.D.
Anthropology, A.M., Ph.D.
Art History, A.M.
Biochemistry, A.M., Ph.D.
Biomedical Engineering, M.S., Ph.D.
Botany, A.M., Ph.D.
Business Administration, M.S.,*
M.B.A., Ph.D.
Chemistry, A.M., Ph.D.
Civil Engineering, M.S., Ph.D.
Classical Studies, A.M., Ph.D.
Computer Science, A.M., Ph.D.
Economics, A.M., Ph.D.
Education, M.Ed., M.A.T., A.M., Ed.D.,
Ph.D.
Electrical Engineering, M.S., Ph.D.
English, M.A.T., A.M., Ph.D.
Forestry, A.M.,† M.S., Ph.D.
Geology, M.S.

Germanic Languages and Literature,
A.M.
Health Administration, M.H.A.
History, M.A.T., A.M., Ph.D.
Mathematics, M.A.T., A.M., M.S.,|| Ph.D.
Mechanical Engineering, M.S., Ph.D.
Microbiology and Immunology, A.M.,
Ph.D.
Pathology, M.S., Ph.D.
Philosophy, A.M., Ph.D.
Physical Therapy, M.S.‡
Physics, A.M., Ph.D.
Physiology, A.M., Ph.D.
Political Science, A.M., Ph.D.
Psychology, A.M., Ph.D.
Religion, A.M.,§ Ph.D.
Romance Languages, A.M., Ph.D.
Sociology, A.M., Ph.D.
Zoology, A.M., Ph.D.

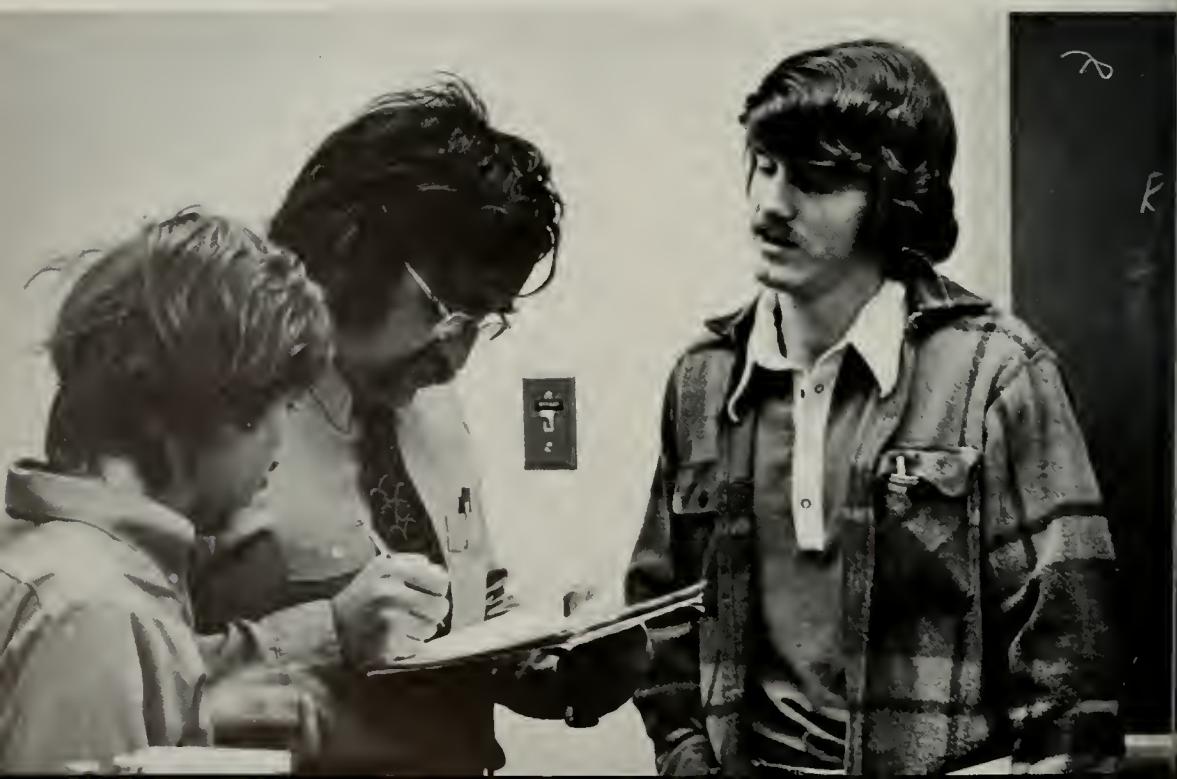
*Applicants should write directly to the Graduate School of Business Administration for further information.

†In addition to the regular advanced degrees in the Graduate School, the School of Forestry offers the professional degrees of Master of Forestry and Doctor of Forestry.

‡Prospective applicants should write directly to the Department of Physical Therapy, Box 3247, Duke Medical Center, Durham, N.C. 27710, for further information.

§In addition to the regular advanced degrees in the Graduate School, the Divinity School offers the professional degrees of Master of Divinity, Master of Religious Education, and Master of Theology.

||In addition to the regular advanced degrees in the Graduate School, the Department of Mathematics offers the Master of Science in Statistics and Computing.



Programs leading to graduate degrees include course and seminar study prescribed by the individual departments. Evidence of command of and training in the tools of research (for example, foreign language); guided and independent reading and laboratory and field experience; a period of residence with constant easy access to the library, laboratory, senior professors, and other graduate students; certain oral and written examinations to exhibit command of the declared field of study; and a master's thesis or doctoral dissertation as a public account of a body of knowledge the student has mastered. (In some departments it is possible to earn an A.M. degree without presentation of a thesis by completing additional course work or other equivalent academic exercises.) A final examination, generally focused upon the thesis or dissertation, enables the student to convince the graduate staff that he has fulfilled all the requirements of his program. Time limitations are set for completion of the program so that the initial ambition in undertaking graduate study and the momentum of accomplishment are not lost.

The Language Requirement

Although individual departments establish their own minimal requirements (see individual departmental headnotes in this Bulletin), the regulations of the Graduate School require no language for the master's degree, and, in most departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. The languages normally required are French, German, and Russian, but others may be offered if appropriate and approved. The foreign language requirement may be satisfied in the following ways: (1) by a passing score on one of the ETS examinations administered at any national center (including Duke and taken no longer than six years before the preliminary examination, (2) by transfer from another institution, with the limitations set forth in the Bulletin of the Graduate School, (3) in any language for which ETS tests are not available, by a reading examination administered by a qualified examiner and arranged by the Graduate School

Office, or (4) by a reading examination in any foreign language, administered by a qualified member of the faculty under a procedure specified by the department and approved by the Dean and the Executive Committee of the Graduate Faculty. In special circumstances a department that wishes to do so may ask the Dean and the Executive Committee of the Graduate Faculty to waive the language requirement.

Foreign students whose native language is not English will be examined during their first registration period in their use of English, and those found deficient will be required to enroll in the course entitled English for Foreign Students. Advanced level, non-credit reading courses in French and German are provided for students who need them.

Other Requirements

The general requirement for a master's degree is a minimum of 30 units (semester hours) of course-seminar-research credit. The student must present acceptable grades for a minimum of 24 units of graduate courses. The nature of the additional 6 units for which he must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., these last 6 units are earned either with successful submission of the thesis or with such other courses or academic exercises as are approved by the student's department. In the M.A.T. program, practice teaching is included for students who lack it, and for them the total units required is a minimum of 36. A pattern of major and related work is prescribed for the course-seminar work, allotting half or more of the units to the major. For example, the M.Ed. allows at least half the units to fall within the student's teaching field, and the M.A.T. allows a major in either education or teaching fields, according to the student's previous training.

A master's program can be completed in one academic year, but the student who presents a thesis usually needs at least a calendar year, and foreign students should be prepared to study for two years. The maximum span of time permitted from first registration to completion of all requirements is



six years. Under certain circumstances a maximum credit of 6 units may be transferred toward the master's degree for graduate courses completed elsewhere, provided the grades earned in the particular courses were not less than *B* or equivalent. In such a case, however, the transfer of graduate credit does not reduce the required minimum registration for a master's degree at Duke.

The course-seminar-research requirement in the doctoral program is a minimum of 60 units, but the proportions of course-seminar work and research are generally flexible according to the student's needs. The applicant

who has already earned the A.M. or M.S. (or for a degree in religion, the B.D. or M.Div.), after establishing the quality of his work here, may be granted transfer credit to a maximum of 30 units, i.e., the equivalent of one year of residence. The dissertation is expected to be a mature and competent piece of writing, embodying the results of original and significant research. All dissertations will be published on microfilm, and the author may retain copyright privileges.

Fairly strict time limitations are set for completion of the doctoral program. The preliminary examination, which may be taken only after language and course-seminar requirements have been met, and which formally admits a student to candidacy for the degree, should be passed by the end of the third year of doctoral study. The interval between preliminary examination and presentation of an acceptable dissertation should ordinarily be one to two years and may not be more than four years without special approval by the Dean. Should this interval extend beyond five years, a second preliminary examination usually becomes necessary.

Financial Regulations

Tuition and fees are charged at the rate of \$78.00 per unit (a unit is equivalent to a semester hour), with the normal full program of study being 30 units for an academic year. Upon successful completion of the preliminary examination and at least 60 units of course-seminar-research credits, the normal full program during the dissertation period is 3 units per semester while in residence, or 1 unit per semester while not in residence. The basic necessary expenses for a year of graduate study, assuming one lives in University graduate dormitories, are therefore approximately as follows:

	First and Second Year	Dissertation Year
Tuition	\$2,580	\$516
Room Rent*	393	393
Board†	750	750

*Depending upon accommodations chosen.

†Cafeteria estimate.

Additional allowances should be made for books, laundry, and other personal expenditures.

Housing is provided for approximately 149 single men and 56 single women in the Graduate Center. The Town House Apartments, located between East and West Campuses, will accommodate both families and single students in 30 air-conditioned apartments.

Planned for completion in 1974, the Central Campus Apartments will provide housing for married and single graduate students. Until the apartments are ready for occupancy, the University will provide assistance to married graduate and professional school students in locating suitable housing in Durham.

Information on fellowships, scholarships, assistantships, and loan provisions is summarized in the section, "How Can I Pay for It?"

The applicant who wishes further information on facilities and regulations on course programs not covered in this Bulletin is invited to write to the Director of Admissions of the Graduate School, or the director of graduate studies in the department of intended study.



Calendar of the Graduate School

Summer Session 1974

First Term: May 14-June 15

Second Term: June 17-July 17

Third Term: July 18-August 17

Academic Year 1974-1975

First Semester: September 3-December 20

Second Semester: January 13-May 6

August 26	Registration for First Semester
September 3	Classes Begin
November 27-December 1	Thanksgiving Recess
December 6-12	Reading Period
December 20	End of First Semester
January 10	Registration for Second Semester
January 13	Classes Begin
March 8-16	Spring Recess
April 22-28	Reading Period
May 6	End of Second Semester
May 11	Commencement



Advanced Degree Programs*



Anatomy

The Department of Anatomy offers graduate programs designed to produce teachers and research workers competent in a broad range of anatomical sciences; both A.M. and Ph.D. degrees are offered. Students with a wide variety of backgrounds and interests in the biological sciences can be accommodated. All students participate in a core anatomical sciences course (Anatomy 301) and gain experience in teaching over the range of departmental interests. Students are encouraged to round out their formal course work by drawing upon the offerings of other departments in the University, as well as those in the Anatomy Department. Laboratories within the department are equipped for and actively support research in several areas, including biochemical and biophysical cytology, biological motility, cell biology, developmental biology, endocrinology, neurobiology, physical anthropology, membrane structure and function, and primate biology. Further information may be obtained from the Director of Graduate Studies of the department.

Professors

John Wendell Everett, Ph.D. (Yale); J. Moses, Ph.D. (Columbia); Talmadge Lee Peele, M.D. (Duke); J. David Robertson, M.D. (Harvard), Ph.D. (MIT). Choirmen

Associate Professors

Shelia J. Counce, Ph.D. (Edinburgh); Kenneth Lindsay Duke, Ph.D. (Duke); William Longley, Ph.D. (London); Michael K. Reedy, M.D. (Washington).

Assistant Professors

Mark Adelman, Ph.D. (Chicago), Director of Graduate Studies; Jan Bergeron, V.M.D. (Pennsylvania); Charles Blake, Ph.D. (California at Los Angeles); Matthew Cartmill, Ph.D. (Chicago); Harold Erickson, Ph.D. (Johns Hopkins); William C. Hall, Ph.D. (Duke); William Hylander, Ph.D. (Chicago); Kurt E. Johnson, Ph.D. (Yale); Moses S. Mahaley, M.D., Ph.D. (Duke).

*For full course descriptions including credit and name of instructor see the official detailed Bulletin of the Graduate School.

Courses of Instruction

- 207. Human Anatomy
- 208. Anatomy of the Trunk
- 215. Contractile Processes
- 219. Molecular and Cellular Basis of Development
- 219S. Seminar
- 231. Human Evolution
- 238. Function and Evolutionary Morphology of Primates
- 240. Mechanisms of Biological Motility
- 246. The Primate Fossil Record
- 261. History of Generation and Mammalian Reproduction
- 263. History of Anatomy
- 264. Mammalian Embryology and Developmental Anatomy
- 266. Topics in Cell Structure and Function
- 276. Comparative Neurology and Psychology
- 280. Molecular Basis of Anatomy
- 286. The Light Microscope, the Electron Microscope, and X-ray Diffraction in Biology
- 288. The Cell in Development and Heredity
- 290. Membrane Structure
- 291. Special Topics in Nerve Ultrastructure
- 300. Gross Anatomy
- 301. Gross Human Anatomy, Microscopic Anatomy, and Neuroanatomy
- 303. Neuroanatomical Basis of Behavior
- 312. Research
- 313, 314. Anatomy Seminar
- 334. Topics in Physical Anthropology
- 340. Tutorial in Advanced Anatomy
- 344. Advanced Neuroanatomy of Sensory and Motor Mechanisms
- 354. Research Techniques in Anatomy
- 418. Reproductive Biology

Anthropology

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Record Examination Aptitude Test.

Candidates for a Ph.D. degree must demonstrate a general competence in four major sub-fields (sociocultural anthropology, physical anthropology, anthropological linguistics, and prehistory) as well as specialization in one or more of these subfields. Recognizing a trend in modern anthropology toward interdisciplinary research, the department allows the student to replace some of the course work required for the Ph.D. by advanced work in anatomy, economics, psychology, sociology, zoology, or other disciplines relevant to a student's program.

Further details of the graduate program, the departmental facilities, the staff, and various stipends available are described in the *Guidelines for Graduate Students in Anthropology* which may be obtained from the Director of Graduate Studies for Anthropology, Department of Anthropology.

Professors

Richard G. Fox, Ph.D. (Michigan); Ernestine Friedl, Ph.D. (Columbia), Chairman and Director of Graduate Studies; Weston LaBarre, Ph.D. (Yale), James B. Duke Professor of Anthropology.

Associate Professor

Mahadeo L. Apte, Ph.D. (Wisconsin).

Assistant Professors

Matthew Cartmill, Ph.D. (Chicago); Ronald W. Casson, Ph.D. (Stanford); William Hylander, Ph.D. (Chicago); William M. O'Barr, Ph.D. (Northwestern); Naomi Quinn, Ph.D. (Stanford).

Instructor

Jonathan M. Kress, Ph.D. (Yale).

Courses of Instruction

- 220. Society and Culture in India
- 222. Topics in African Anthropology
- 231. Human Evolution I
- 242. Topics in Prehistory
- 243. Seminar in Theory and Method in Archaeology
- 244. Primate Behavior
- 245. Functional and Evolutionary Morphology of Primates
- 246. The Primate Fossil Record
- 249. Topics in Economic Anthropology
- 250. The Anthropology of Cities

- 251. Ethnography of Humor
- 259. Linguistic Anthropology: Language Acquisition
- 260. Linguistic Anthropology: Phonemics
- 261. Linguistic Anthropology: Morphology and Syntax
- 262. Anthropology of Law
- 263. Primitive Art and Music
- 264. Primitive Religion
- 265. Personality and Society
- 266. Personality and Culture
- 270. Seminar in Ethnographic Field Methods
- 271. Seminar in Methods of Data Analysis
- 275. Rank, Power, and Authority in Pre-Industrial Societies
- 276. Analysis of Kinship Systems
- 278. Special Topics in Political Anthropology
- 280, 281. Seminar in Selected Topics
- 291, 292. Anthropological Theory
- 330, 331. Seminar in Anthropology
- 334. Topics in Physical Anthropology
- 335, 336. Linguistic Theory and Methods
- 393. Individual Research in Anthropology
- 402. Interdisciplinary Seminar in History of the Social Sciences
- 410. Seminar in the Government, History, and Social Structure of India and Pakistan

Art

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required to attend prescribed undergraduate courses. A reading knowledge of one foreign language (preferably German) is required; candidates who do not meet this requirement upon admission to the program are expected to do so by the end of their first term in residence.

The program for the A.M. degree in art history consists of 30 units, as follows: 12 units in art history; 6 units in an approved minor; 6 units in the major or minor, or other approved subject; and 6 units in thesis. A written thesis is required. The candidate must also pass a written comprehensive examination testing his knowledge of art history and pertinent bibliographical resources.

Professors

Dario Covi, Ph.D. (New York). Chairman; Louise Hall, Ph.D. (Radcliffe); William S. Heckscher, Ph.D. (Hamburg). Benjamin N. Duke Professor of Art; Marianna Jenkins, Ph.D. (Bryn Mawr); Sidney David Markman, Ph.D. (Columbia). Director of Graduate Studies; Earl George Mueller, Ph.D. (Iowa State); Elizabeth Read Sunderland, Ph.D. (Radcliffe).

Lecturer

Karla Langedijk, Ph.D. (Amsterdam).

Courses of Instruction

- 217. Aegean Art
- 218. Early Greek Art
- *233. Early Mediaeval Architecture
- *234. Romanesque Sculpture
- 237. French Renaissance Art
- 238. Sienese Painting
- 239. Architecture of Britain
- 240. Architecture of North America
- 241. Problems in Latin American Art
- 247. Problems in the History of Graphic Arts
- 248. Studies in Florentine Painting
- 249. Problems in Pre-Columbian Art and Archaeology
- 251-252. Research
- 253. Studies in Italian Renaissance Sculpture
- 255, 256. Iconological Problems
- 291, 292. Museology Seminar
- 293, 294. Special Problems in Art History
- 399. Directed Reading and Research

*Offered upon demand.

Asian Languages

200-201. Special Studies in South Asian Languages: Hindi-Urdu

Biochemistry

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcomed, but adequate preparation in chemistry is essential. Graduate specialization areas include protein structure and function, crystallography of macromolecules, nucleic acid structure and function, lipid biochemistry, membrane structure and function, molecular genetics, and enzyme chemistry and neurochemistry. The Division of Genetics of the department, in cooperation with the University Program in Genetics, offers biochemistry students the opportunity to pursue advanced research and study to fulfill the requirements for the Ph.D. degree.

Professors

Irwin Fridovich, Ph.D. (Duke); Samson R. Gross, Ph.D. (Columbia). Director of the Genetics Division: Walter R. Guild, Ph.D. (Yale); Philip Handler,* Ph.D. (Illinois); Robert Hill, Ph.D. (Kansas). Chairman: Henry Kamen, Ph.D. (Duke); Norman Kirshner, Ph.D. (Pennsylvania State). Director of Graduate Studies: Kenneth S. McCarty, Ph.D. (Columbia); Charles Tanford, Ph.D. (Princeton). James B. Duke Professor of Physical Biochemistry.

Associate Professors

Stanley H. Appel, M.D. (Columbia); Ronald C. Greene, Ph.D. (California Institute of Technology); Jerome S. Harris, M.D. (Harvard); Bernard Kaufman, Ph.D. (Indiana); William Sanford Lynn, M.D. (Columbia); K. V. Rajagopalan, Ph.D. (University of Madras); Harvey J. Sage, Ph.D. (Yale); Robert E. Webster, Ph.D. (Duke).

Assistant Professors

Robert Bell, Ph.D. (California at Berkeley); Robert L. Habig, Ph.D. (Purdue); Dwight H. Hall, Ph.D. (Purdue); Philip D. Harriman, Ph.D. (California at Berkeley); William N. Kelley, M.D. (Emory); Sung-Hou Kim, Ph.D. (Pittsburgh); Nicholas M. Kredich, M.D. (Michigan); Robert J. Lefkowitz, M.D. (Columbia); P.A. McKee, M.D. (Oklahoma); Jacqueline A. Reynolds, Ph.D. (Washington University); David C. Richardson, Ph.D. (MIT); Lewis M. Siegel, Ph.D. (Johns Hopkins); James B. Sullivan, Ph.D. (Texas); Robert W. Wheat, Ph.D. (Washington University).

*On leave of absence.

Associates

John A. Bittikofer, Ph.D. (Purdue); Joseph Bonaventura, Ph.D. (Texas); Joe M. McCord, Ph.D. (Duke); Yasuhiko Nozaki, Ph.D. (Tokyo University); Howard Steinman, Ph.D. (Yale).

Courses of Instruction

204. Introductory Genetics	286. Current Topics in Immunochemistry
208. Laboratory Methods in Biochemistry	288. The Carbohydrates and Lipids of Biological Systems
209-210. Independent Study	290. Bioenergetics
216. Molecular Genetics	293. Macromolecules
219. Molecular and Cellular Basis of Development	294. Nucleic Acids and Macromolecular Synthesis
219L. Laboratory	295. Enzyme Mechanisms
219S. Seminar	296. Biological Oxidations
222. Structures of Biological Macromolecules	297. Intermediary Metabolism
241. General Biochemistry	298. Regulation of Cellular Metabolism
247. Introductory Biochemistry	299. Nutrition
276. Comparative and Evolutionary Biochemistry	302. Neurochemistry
282. Experimental Genetics	345, 346. Biochemistry Seminar
284. Current Topics in Genetic Mechanisms	351, 352. Genetics
	390. Biochemistry of Membranes
	395. Biochemical Pharmacology

Botany

Graduate work in the Department of Botany is offered leading to the A.M. and Ph.D. degrees. Before undertaking graduate study in botany a student should have

had in his undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. Graduate Record Examination scores are required of all applicants. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

Professors

Lewis Edward Anderson, Ph.D. (Pennsylvania); William Dwight Billings, Ph.D. (Duke); James B. Duke Professor of Botany; William Lewis Culberson, Ph.D. (Wisconsin); Henry Hellmers, Ph.D. (California at Berkeley); Terry W. Johnson, Ph.D. (Michigan), Director of Graduate Studies; Paul Jackson Kramer, Ph.D. (Ohio State); James B. Duke Professor of Botany; Aubrey Willard Naylor, Ph.D. (Chicago); James B. Duke Professor of Botany; Jane Philpott, Ph.D. (State Univ. of Iowa); Donald E. Stone, Ph.D. (California at Berkeley); Richard A. White, Ph.D. (Michigan); Robert L. Wilbur, Ph.D. (Michigan), Chairman.

Associate Professors

Janis Antonovics, Ph.D. (Wales); Richard T. Barber, Ph.D. (Stanford); John E. Boynton, Ph.D. (California at Davis); Kenneth R. Knoerr, Ph.D. (Yale); Richard B. Searles, Ph.D. (California at Berkeley); Boyd R. Strain, Ph.D. (California at Los Angeles).

Assistant Professors

William F. Blankley, Ph.D. (California at San Diego); Norman L. Christensen, Jr., Ph.D. (California at Santa Barbara).

Lecturer

C. F. Culberson, Ph.D. (Duke).

Courses of Instruction

203. Cytogenetics	250. Plant Biosystematics
203L. Laboratory in Cytogenetics	251. Physiology
204. Introductory Marine Microbiology	252. Plant Metabolism
205. Anatomy	254. Plant-Water Relations
206. Anatomy of Woody Plants	255. Plant Systematics
209. Lichenology	257. Principles of Plant Distribution
210. Bryology	258. Physiology of Growth and Development
211. Marine Phycology	259. The Environment
212. Phycology	265. Physiological Plant Ecology
221. Mycology	266. Analysis and Classification of Vegetation
225, 226. Special Problems	280. Principles of Genetics
236. Major Global Ecosystems	285. Population Genetics
242. Systematics	286. Evolution
245. Plant Diversity	359-360. Research in Botany
246. Ecology	
248. Introductory Biochemistry	

Business Administration

The Graduate School of Business Administration offers work leading to the M.B.A., Ph.D., and the M.S. in Management Sciences. The M.B.A. program is designed for students whose undergraduate work included at least one year of calculus and an educational background adequate for rigorous analysis. Usually, undergraduate majors in such fields as the physical and biological sciences, mathematics, engineering, and the social sciences are well suited for the program. The M.B.A. program is designed to provide a thorough foundation in the concepts and theory that underlie the design, operation, and control of modern complex organizations.

The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The doctoral level course work presumes either a Duke M.B.A. or the equivalent. One year of study (30 semester hours) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study

should include two courses in advanced economic theory, two courses in mathematics or statistics, one course in philosophy of science, and three courses in an elected field of administration. The latter are individually designed and are offered on a tutorial basis to provide extensive reading in the historical and current literature, and a demanding research program.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

Professors

Helmy H. Baligh, Ph.D. (California at Berkeley); Thomas F. Keller, Ph.D. (Michigan); Dan J. Laughhunn, D.B.A. (Illinois); David W. Peterson, Ph.D. (Stanford).

Associate Professors

Kenneth R. Baker, Ph.D. (Cornell); Joseph Battle, Ph.D. (Michigan); Richard M. Burton, D.B.A. (Illinois); David C. Dellinger, Ph.D. (Stanford).

Assistant Professors

Carole A. Aldrich, Ph.D. (Carnegie-Mellon); William W. Damon, Ph.D. (Cornell); Arthur J. Kuhn, Ph.D. (California at Berkeley); Steven F. Maier, Ph.D. (Stanford); Russell J. Petersen, Ph.D., C.P.A. (Washington); James H. Vander Weide, Ph.D. (Northwestern); Julie H. Zalkind, Ph.D. (Johns Hopkins).

Courses of Instruction for the M.B.A.

First Year Requirements

300-301. Managerial Theory of the Firm	321. Management of Information and Control Systems II
310. Foundations for Quantitative Analysis I	330, 331. Organization Theory and Management
311. Foundations for Quantitative Analysis II	341. Macroeconomic Analysis
320. Management of Information and Control Systems I	

Second Year Requirements

302. Cooperative Decisions and Competitive Strategies	332. Organization Design and Internal Operations
303. Cooperative-Competitive Relations and Decisions	349. Law as a Constraint for Business
312. Operations Research	350. Public Policy of the Firm
	390. The Practicum

Electives

313. Advanced Operations Research	351. Finance
323. Controllership	353. Marketing
324. External Reporting and Auditing	355. Production
333. Manpower Planning and Management	

Courses for the M.S. in Management Sciences

300. Managerial Economics	340. Controllership
302. Planning and Internal Organization	341. Marketing Management
310. Mathematics for Management	342. Financial Management
311. Probability and Statistics	343. Production Management
312. Operations Research	344. Human Resource Management
320. Organization Analysis and Operation Design	350. Social Issues and the Complex Organization
330. Accounting and Control Systems	390. Practicum

Courses for the Ph.D. in Business Administration

309.1-.9. Research in Managerial Economics	329.1-.9. Research in Information and Accounting Systems
319.1-.9. Research in Quantitative Methods	

339.1-.9. Research in Organization Theory and Management	354.1-.9. Research in Marketing
348.1-.9. Research in Public Policy and Social Responsibility	356.1-.9. Research in Production
352.1-.9. Research in Finance	391.1-.3. Supervised Independent Research
	392-393. Tutorial in Interdisciplinary Areas
	397. Dissertation Research

Chemistry

In the Department of Chemistry graduate work is offered leading to the A.M. and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields. A booklet providing detailed information on the department is available from the Director of Graduate Studies.

Professors

Charles Kilgo Bradsher, Ph.D. (Harvard); James B. Duke Professor; Donald B. Chesnut, Ph.D. (California Institute of Technology), Director of Graduate Studies; Marcus Edwin Hobbs, Ph.D. (Duke); Peter W. Jeffs, Ph.D. (Natal); William R. Krigbaum, Ph.D. (Illinois); James B. Duke Professor; Andrew T. McPhail, Ph.D. (Glasgow); William E. Parham, Ph.D. (Illinois); R.J. Reynolds Company Professor of Chemistry; Jacques C. Poirier, Ph.D. (Chicago); Louis DeBose Quin, Ph.D. (North Carolina); Chaimon; Peter Smith, Ph.D. (Cambridge); Howard Austin Strobel, Ph.D. (Brown); Richard L. Wells, Ph.D. (Indiana); Pelham Wilder, Jr., Ph.D. (Harvard).

Associate Professors

Robert W. Henkens, Ph.D. (Yale); Richard A. Palmer, Ph.D. (Illinois).

Assistant Professors

Roger W. Baier, Ph.D. (Washington); Steven Baldwin, Ph.D. (California Institute of Technology); Alvin L. Crumbliss, Ph.D. (Northwestern); William Gutknecht, Ph.D. (Purdue); Charles H. Lochmüller, Ph.D. (Fordham); Ned Allen Porter, Ph.D. (Harvard).

Adjunct Professor

Anton Peterlin, Ph.D. (University of Berlin).

Adjunct Associate Professors

Robert G. Ghirardelli, Ph.D. (California Institute of Technology); Colin G. Pitt, Ph.D. (London); David Rosenthal, Ph.D. (MIT); Bernard F. Spielvogel, Ph.D. (Michigan).

Courses of Instruction

201. Molecular Spectroscopy	322. Organic Reactive Intermediates
203. Quantum Chemistry	323, 324. Special Topics in Organic Chemistry
205. Structure and Reaction Dynamics	330. Chemical Separation Methods and Kinetics in Analytical Chemistry
207. Principles of Thermodynamics, Diffraction, and Kinetics	331, 332. Special Topics in Analytical Chemistry
240. Chemical Oceanography	334. Chemical Instrumentation and Applied Spectroscopy
300. Basic Statistical Mechanics	373, 374. Seminar
302. Basic Quantum Mechanics	375, 376. Research
303, 304. Special Topics in Physical Chemistry	377. Research Orientation Seminar
310. Theoretical and Structural Inorganic Chemistry	
312. Inorganic Reactions and Mechanisms	
313, 314. Special Topics in Inorganic Chemistry	
320. Synthetic Organic Chemistry	

Classical Studies

The Department of Classical Studies offers two programs leading to the Ph.D. degree, one with emphasis on literature and philology, the other with emphasis on ancient history and archaeology. For regular admission to the program in literature and philology a student must offer three years of college study above the elementary level in one of the classical languages and two college years in the other. Students wishing to enter the program in ancient history and archaeology will be required on entrance to demonstrate satisfactory competence in both Greek and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficiency.

The department's special requirements in addition to the general requirements of the University for the Ph.D. degree set forth in the section on Program Information in the detailed official *Bulletin of the Graduate School* are presented in a sheet that may be obtained from the Director of Graduate Studies. They include special requirements on seminars, course work, and the preliminary examination for the Ph.D. degree.

A reading knowledge of German and French is required of all candidates for the Ph.D. degree. The candidate should meet one of the language requirements by the end of his first term in residence and the other by the end of his third term.

Professors

Francis Newton, Ph.D. (North Carolina), Director of Graduate Studies; John F. Oates, Ph.D. (Yale), Chairman; Lawrence Richardson, Jr., Ph.D. (Yale), F.A.A.R.; James N. Truesdale, Ph.D. (Duke); William H. Willis, Ph.D. (Yale).

Associate Professor

Dennis Keith Stanley, Ph.D. (Johns Hopkins).

Assistant Professors

Peter H. Burian, Ph.D. (Princeton); Charles Edwin V. Nixon, Ph.D. (Michigan); Kent J. Rigsby, Society of Fellows (Harvard).

Visiting Lecturer

Harry L. Levy, Ph.D. (Columbia).

GREEK

Courses of Instruction

200. Graduate Reading	231. Hellenistic Poetry
*203. Homer	241. Advanced Prose Composition
205. Greek Lyric Poets	301. Greek Seminar I
*206. Aeschylus	302. Greek Seminar II
*208. Sophocles	303. Greek Seminar III
*209. Euripides	304. Greek Seminar IV
*210. Aristophanes	305. Greek Seminar V
*221. Early Greek Prose	306. Greek Seminar VI
*222. Thucydides	311. Proseminar in Papyrology
*223. Greek Orators I	313. Proseminar in Greek Epigraphy
*224. Greek Orators II	321. Seminar in Literary Papyri
*225. Plato	323. Seminar in Documentary Papyri
	399. Directed Reading and Research

*Not offered in 1974-75.

LATIN

200. Graduate Reading	*207. The Prose Epistle
201. The Verse Treatise	*208. The Epistle in Verse
202. Roman Satire	*209. Fragments of Early Latin
*203. Epic: Vergil	*210. Lyric and Occasional Poetry
204. Epic: Lucan and Statius	*211. Roman Oratory I

- *212. Roman Oratory II
- *221. Mediaeval Latin I
- *222. Mediaeval Latin II
- *225. Palaeography
- *241. Advanced Latin Composition
- 301. Latin Seminar I
- 302. Latin Seminar II
- 303. Latin Seminar III
- 304. Latin Seminar IV
- 305. Latin Seminar V
- 306. Latin Seminar VI
- 312. Proseminar in Latin Palaeography
- 314. Proseminar in Latin Epigraphy
- 315. Proseminar in Roman Law
- 399. Directed Reading and Research

*Not offered in 1974-75.

CLASSICAL STUDIES

301. Introduction to Classical Philology

CLASSICAL STUDIES (ANCIENT HISTORY)

- *253. Greece to the Orientalizing Period
- *254. The Age of the Tyrants and the Persian Wars
- *255. The Age of Pericles
- *256. The Fourth Century through Alexander
- 257. Social and Cultural History of the Hellenistic World from Alexander to Augustus
- 258. Social and Cultural History of the Graeco-Roman World
- *260. The History of Rome to 146 B.C.
- *261. The Roman Revolution, 146-30 B.C.
- *262. Rome under the Julio-Claudians
- *263. From the Flavian Dynasty to the Severan
- *264. From Septimius Severus to Constantine
- *270. The Rise of the Hellenistic Kingdoms
- *271. The Hellenistic Kingdoms 250-31 B.C.
- 321. Seminar in Ancient History I
- 322. Seminar in Ancient History II
- 323. Seminar in Ancient History III
- 324. Seminar in Ancient History IV
- 325. Seminar in Ancient History V
- 326. Seminar in Ancient History VI
- 327. Seminar in Byzantine History
- 399. Directed Reading and Research

*Not offered in 1974-75.

CLASSICAL STUDIES (ARCHAEOLOGY)

- *231. Greek Sculpture
- *232. Greek Painting
- *235. Roman Architecture
- *236. Roman Painting
- 311. Archaeology Seminar I
- 312. Archaeology Seminar II

*Not offered in 1974-75.

Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve in the minor programs of students in other departments. Consult Professor Salinger, Department of Germanic Languages and Literature.

Courses of Instruction

- 201, 202. Romanticism
- 203, 204. Realism and Symbolism
- 205. Foundations of Twentieth-Century European Literature
- 206. Autobiography

- 213. The Slavs: Literature and Culture, 1918-1939
- 214. The Slavs: Literature and Culture, 1940-1970
- 301. The Hero in European Fiction, 1830-1940

Computer Science

The Department of Computer Science offers programs leading to the A.M. and Ph.D. degrees. A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus and of at least two computer programming languages. Research interests of present faculty include mathematical foundations of computer science, artificial intelligence, program

verification, compiler design, real-time computing, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

Professors

Thomas M. Gallie, Ph.D. (Rice); Donald W. Loveland, Ph.D. (New York University), Chairman; Peter N. Marinos, Ph.D. (North Carolina State); Thomas H. Naylor, Ph.D. (Tulane); Loren Nolte, Ph.D. (Michigan); Max A. Woodbury, Ph.D. (Michigan).

Associate Professors

William E. Hammond, Ph.D. (Duke); Merrell L. Patrick, Ph.D. (Carnegie Institute of Technology), Director of Graduate Studies; Charles Starmer, Ph.D. (North Carolina).

Assistant Professors

Alan W. Biermann, Ph.D. (California at Berkeley); Susan L. Gerhart, Ph.D. (Carnegie-Mellon); Dietolf Ramm, Ph.D. (Duke).

Adjunct Associate Professor

Leland Williams, Ph.D. (Duke).

Courses of Instruction

201. Programming Languages	241, 242. Information Organization and Retrieval
203. Random Signals and Noise	244. Econometrics II
205. Signal Detection and Extraction Theory	250. Clustering and Classification
208. Digital Computer Design	251. Computer Science for Teachers
210. Image Processing	265. Advanced Topics in Computer Science
211. Control Programs in Operating Systems	306. Adaptive Detection and Communication Systems
212. Advanced Topics in Control Programs	307. Advanced Digital Systems I
215. Artificial Intelligence	308. Advanced Digital Systems II
221. Numerical Analysis I	311. Inverse Models
222. Numerical Analysis II	321. Topics in Numerical Mathematics
223. Numerical Analysis III	344. Workshop on Computer Models of Social Systems
225. Mathematical Foundations of Computer Science	350. Advanced Engineering Analysis
231. Introduction to Operating Systems	
232. Metaprograms	

Economics

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. Among the undergraduate courses of distinct advantage to the graduate student in economics are general accounting, elementary statistics, intermediate economic theory, money and banking, international trade, and basic courses in philosophy, mathematics, and social sciences other than economics. Advanced work in mathematics or statistics is also useful.

Requirements for the Ph.D. in economics include an examination in economic theory at the end of the first year, and at the end of the second year examinations in three additional fields. The student may select these from advanced economic theory, history of political economy, economic development, economic history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, statistics, Soviet economics, and certain fields outside the Economics Department (e.g., demography). Course work for the Ph.D. should be completed in four semesters of residence.

Professors

John Oliver Blackburn, Ph.D. (Florida); Martin Bronfenbrenner, Ph.D. (Chicago), William R. Kenan, Jr. Professor of Economics; David George Davies, Ph.D. (California at Los Angeles); Frank Traver de Vyver, Ph.D. (Princeton); Craufurd David Goodwin, Ph.D. (Duke); Allen C.

Kelley, Ph.D. (Stanford); Chuirmon; Juanita Morris Kreps, Ph.D. (Duke); James B. Duke Professor of Economics; Thomas Herbert Naylor, Ph.D. (Tulane); Lloyd Blackstone Saville, Ph.D. (Columbia); Vladimir G. Treml, Ph.D. (North Carolina); John M. Vernon, Ph.D. (MIT); William Poe Yohe, Ph.D. (Michigan).

Associate Professors

Henry Grabowski, Ph.D. (Princeton); Thomas M. Havrilesky, Ph.D. (Illinois); Eliot Roy Weintraub, Ph.D. (Pennsylvania), Director of Graduate Studies.

Assistant Professors

David E. Black, Ph.D. (MIT); Neil de Marchi, Ph.D. (Australian National University); Daniel A. Graham, Ph.D. (Duke); Marjorie McElroy, Ph.D. (Northwestern); Jay S. Salkin, Ph.D. (Northwestern).

Courses of Instruction

200. Capitalism and Socialism	319. Seminar in the Theory and the Problems of Economic Growth and Change
204. Advanced Money and Banking	320. Macroeconomic Analysis I
231. Economic Development of Europe	321. Theory of Quantitative Economic Policy
*233. State and Urban Finance	322. Macroeconomic Analysis II
237, 238. Statistical Methods	323. Income Distribution Theory
243. Econometrics I	329. Federal Finance
244. Computer Simulation Models of Economic Systems	330. Seminar in Public Finance
245. Econometrics II	331. Seminar in Economic History
262. Trade Unionism and Collective Bargaining	344. Workshop on Computer Models of Social Systems
265. International Trade and Finance	345, 346. Demographic Techniques I and II
287. Public Finance	350. Seminar in Applied Economics
293. Soviet Economic History	355. Seminar in Labor Economics
294. Soviet Economic System	358. Seminar in Labor Market and Related Analysis
301. Microeconomic Analysis I	365. Seminar in International Economics
302. Microeconomic Analysis II	366. Monetary Aspects of International Trade and Finance
303. Theory of Economic Decision-Making	*388. Industrial Organization
304, 305. Seminar in Money and Banking	*389. Seminar in Industrial and Governmental Problems
307. Quantitative Analysis I	397, 398. Directed Research
308. Quantitative Analysis II	401. Seminar on the British Commonwealth
311, 312. History of Political Economy	402. Interdisciplinary Seminar in the History of the Social Sciences
313, 314. Seminar in Economic Theory	
316. Seminar in Economics of Soviet-Type Socialism	
317. Seminar in Demographic, Population, and Resource Problems	
318. Dissertation Seminar	

*Offered on demand.

Education

Graduate work in education is offered leading to the A.M., M.Ed., M.A.T., Ed.D., and Ph.D. degrees. For each of these degrees there are specific requirements and prerequisites, all of which may be found stated in detail in the official detailed Bulletin of the Graduate School. Departmental requirements and prerequisites for all of these degrees may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selection may be made which will meet North Carolina requirements for the advanced Principal's Certificate and the Superintendent's Certificate. (Some courses below are offered only in the summer session; see the Bulletin of the Summer Session.)

These programs are accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel, with the doctor's degree as the highest degree approved.

Professors

Anne H. Adams, Ed.D. (Mississippi); William H. Cartwright, Ph.D. (Minnesota), Director of Graduate Studies; W. Scott Gehman, Jr. Ph.D. (Pennsylvania); Sherwood Githens, Jr., Ph.D. (North Carolina); Everett H. Hopkins, M.A. (Wittenburg), Director of Cooperative Programs; Allan S. Hurlburt, Ph.D. (Cornell), Chairman; Olan Lee Petty, Ph.D. (Iowa); R. Baird Shuman, Ph.D. (Pennsylvania); Henry Weitz, Ed.D. (Rutgers).

Associate Professors

Robert H. Ballantyne, Ed.D. (Washington State); Peter F. Carbone, Ed.D. (Harvard); Robert Merle Colver, Ed.D. (Kansas); Lucy T. Davis, Ed.D. (Columbia); Joseph Di Bona, Ph.D. (California at Berkeley); Anne Flowers, Ed.D. (Duke); Charles B. Johnson, Ed.D. (Duke); William G. Katzenmeyer, Ed.D. (Duke); David V. Martin, Ed.D. (Duke); Robert A. Pittillo, Jr., Ed.D. (Duke); Henry L. Sublett, Ed.D. (Virginia).

Adjunct Professor

J.A. Davis, Ph.D. (Columbia).

Part-Time Instructor

Myrtle T. Swain, Ed.D. (Duke).

Courses of Instruction

- 201. Teaching and Supervision of Arithmetic
- 202. Comparative and International Education: Industrialized Nations
- 204. Educational Organization
- 206. Studies in the History of Educational Philosophy
- 207. Social History of Twentieth Century American Education
- 209. John Dewey
- 210. The Politics of Education
- *213. Elementary School Organization and Administration
- 215. Secondary Education: Principles
- 216. Secondary Education: Internship
- 217. The Psychological Principles of Education
- 218. Comparative and International Education: Developing Societies
- 219. Comparative and International Education: South Asia
- 221. Programs in Early Childhood Education
- 222. New Developments in Elementary School Curriculum
- *223. Teaching the Language Arts
- 224. Teaching the Social Studies in Elementary Schools
- 225. The Teaching of History and the Social Studies
- 226. Teaching Developmental and Remedial Reading in the Elementary School
- 227. The Teaching of Geography
- 229. Formal and Informal Classroom Diagnosis of Reading Disability Cases
- 233. Improvement of Instruction in English
- 234. Secondary School Organization and Administration
- 236. Teaching Developmental and Remedial Reading in the Secondary School
- 237. The Teaching of Literature in Secondary Schools
- 238. Content, Supervision, and Administration of Reading Programs
- 239. The Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School
- 240. Career Development
- 241. Foundations of Counseling and Personnel Services
- 243. Personality Dynamics
- 244. Counseling Techniques
- 245. Theories of Counseling
- 246. The Teaching of Mathematics
- 247. Practicum in Guidance and Counseling
- 248. Practicum in Counseling
- 249. Exceptional Children
- 250, 251. Teaching Emotionally Disturbed Children: Internship
- *252. The School in the Legal Structure
- 253. Law and Education
- 255. Assessment of Abilities
- 256. Classroom Assessment of Student Achievement
- 258. Assessment of Personality, Interests, and Attitudes
- 260. Introduction to Educational Research
- 261. Intermediate Educational Research
- 266. Basic Science for Teachers
- 268. Seminar in Contemporary Educational Criticism
- 270. The Junior College
- 271. Instructional Systems for Junior/Community College
- 272. Teaching Communication Skills in Early Childhood Education
- 273, 274. Clinical Reading Practicum
- 276. The Teaching of High-School Science
- 285. Audio-Visual Aids in Education
- 291. Public and Community Relations of School
- 300. Individual Assessment of Intelligence

- 301. Advanced Individual Assessment of Cognitive Abilities
- 302. Seminar in Educational Research
- 306. Seminar in Philosophical Analysis of Educational Concepts
- 309. Higher Education in the United States
- 310. Seminar in Higher Educational Administration
- 311. Group Counseling
- 313. Seminar in Education and Public Policy
- 314. Seminar in Guidance and Counseling
- 315. Seminar in Secondary School Teaching
- 316, 317. Practicum in Higher Educational Research and Development
- 321. Educational Management
- 322. Planning and Management of Educational Facilities
- *323. Public School Finance
- 326. Educational Psychology: The Problem Child
- 332. Supervision of Instruction
- 335, 336. Seminar in School Administration
- 337. Seminar in Community College Organization
- 338. Seminar in Educational Supervision
- 339. Seminar in Curriculum
- 340. Seminar in Social Studies Curriculum
- 341. Seminar in Elementary School Curriculum
- 342. Seminar in Secondary School Curriculum
- 343. History of Higher Education in America
- 344. Research in Higher Education
- 345. Seminar in Reading Instruction and Research
- 346. Seminar in Organization of Pre-Service and In-Service Reading Programs
- 347. Student Personnel Services in Higher Education
- 348, 349. Seminar in Child Psychopathology
- 350, 351. Directed Activities in Education
- 354. Seminar in Law and Educational Organization
- 360. Seminar on Instructional Strategies

*Offered on demand.

Engineering

George Wilbur Pearsall, Sc.D., Dean

The School of Engineering offers programs of study and research leading to the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, electrical, or mechanical engineering. These programs are designed to provide a fundamental understanding of the science of engineering, which is based on mathematics and the physical sciences, and to develop experience in the art of engineering, which depends on human imagination and judgment. Each engineering graduate student may participate in seminars appropriate to his field of study.

A minimum of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (usually mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A non-thesis option requiring 30 units of course credit is available. Each of the departments imposes additional requirements in the exercise of this option. There is no language requirement for this degree.

A minimum of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree in biomedical, civil, and electrical engineering, 24 in the major, 12 in related minor work (usually mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department and the Dean of the School of Engineering, and 12 for a research-based dissertation. In mechanical engineering there are no overall course requirements; each program is planned to meet individual needs. The directors of graduate studies will, during the first period of full-time registration of each doctoral aspirant, appoint a program advisory committee consisting of three members of the graduate faculty in areas relevant to the student's intended major. The preliminary examination may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

BIOMEDICAL ENGINEERING

Biomedical engineering, is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology

and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering. The major research areas available include: biomechanics, biomedical materials, biomedical modeling, data acquisition and processing, and electrophysiology.

Professors

Peter B. Bennett, Ph.D. (South Hampton); James H. McElhaney, Ph.D. (West Virginia); Loren Nolte, Ph.D. (Michigan); Theo Clyde Pilkington, Ph.D. (Duke), Choirmon; Frederick L. Thurstone, Ph.D. (North Carolina State), Director of Graduate Studies; Myron Wolbarsht, Ph.D. (Johns Hopkins).

Associate Professors

Roger Barr, Ph.D. (Duke); Howard Clark, Ph.D. (Maryland); William E. Hammond, Ph.D. (Duke); Brian A. Hills, Ph.D. (Adelaide); Howard C. Wachtel, Ph.D. (New York University).

Assistant Professor

Evan A. Evans, Ph.D. (California at San Diego).

Courses of Instruction

201. Analysis of Bioelectric Phenomena	311. Inverse Models
202. Energy and Rate in Biomedical Processes	325. Microcirculation: Rheology and Transport
223. Biomedical Materials and Artificial Organs	333. Biomedical Imaging
265. Advanced Topics in Biomedical Engineering	399. Special Readings in Biomedical Engineering

CIVIL ENGINEERING

A student may specialize in one of the following fields of study for either the M.S. or the Ph.D. degree: environmental engineering; geotechnical engineering and soil mechanics; mechanics of solids; materials engineering; fluid mechanics, water resources, and ocean engineering; structural engineering; and urban systems and transportation. Interdisciplinary programs combining study in some of the major areas with biological sciences, business administration, materials science, social sciences, political science, and other areas of engineering are also available. In addition, there is a special program leading to the M.S. degree in Civil Engineering and the A.M. degree in Public Policy Sciences.

With the approval of the department, a master's degree candidate in civil engineering may choose, in lieu of submitting a thesis, to complete an additional 6 units of course work plus a special project. If the candidate elects this alternative, he is expected to take a comprehensive examination over his graduate course work, and also to defend orally his special project.

Under the Reciprocal Agreement with Neighboring Universities, a student may include, as a portion of the minimum requirements, work offered by the Department of Environmental Sciences and Engineering of the University of North Carolina. Although related work usually is taken in the natural sciences or mathematics, a student whose major interest relates to the social or managerial sciences may take relevant work in these areas.

A minimum prerequisite to the graduate program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics.

Professors

Earl I. Brown, Ph.D. (Texas), J.A. Jones Professor of Civil Engineering; Senol Utku, Sc.D. (MIT); Aleksandar Sedmak Vesic, D.Sc. (Belgrade), J.A. Jones Professor of Civil Engineering and Choirmon.

Associate Professors

G. Wayne Clough, Ph.D. (California at Berkeley); J. Dvorak, Ph.D. (Brown), Director of Graduate Studies; Bruce J. Muga, Ph.D. (Illinois); Aubrey E. Palmer, C.E. (Virginia); James F. Wilson, Ph.D. (Ohio State).

Assistant Professors

Jarir Dajani, Ph.D. (Northwestern); P. Aarne Vesilind, Ph.D. (North Carolina).

Adjunct Assistant Professor

Robert J. Drye, Jr., Ph.D. (North Carolina).

Courses of Instruction

201. Advanced Mechanics of Solids	236. Earth Structures
202. Experimental Mechanics	238. Rock Mechanics
203. Elastic Stability	241. Environmental Engineering Chemistry and Biology
204. Plates and Shells	243, 244. Sanitary Engineering Unit Operations and Process Design
205. Elasticity	247. Air Pollution Control
210. Intermediate Dynamics	248. Solid Waste Management
212. Mechanical Behavior of Materials	250. Engineering Analysis
215. Urban and Regional Geography	304. Advanced Plates and Shells
216. Transportation Planning and Policy Analysis	305. Advanced Elasticity
217. Urban and Environmental Systems Analysis	306. Plasticity
221. Incompressible Fluid Flow	307. Viscoelasticity
222. Open-Channel Flow	309. Advanced Dynamics
223. Flow Through Porous Media	331. Advanced Structural Analysis I
224. Coastal and Offshore Engineering	332. Advanced Structural Analysis II
225. Engineering Hydrology	335. Mechanical Behavior of Soils
230. Matrix Methods for Structural Analysis	336. Advanced Soil Mechanics
231. Structural Engineering Analysis	337. Elements of Soil Dynamics
232. Reinforced Concrete Design	350. Advanced Engineering Analysis
233. Prestressed Concrete Design	365. Advanced Topics in Civil Engineering
234. Structural Design in Metals	399. Special Readings in Civil Engineering
235. Foundation Engineering	

ELECTRICAL ENGINEERING

A student may specialize in any of the following fields in working toward either the M.S. or the Ph.D. degree: solid-state materials and devices, ferromagnetics, superconducting circuits, instrumentation, electronics, microwaves and automatic control, energy conversion, digital systems, and information processing.

Recommended prerequisites for the graduate courses in electrical engineering include a knowledge of basic mathematics and physics, electromagnetic theory, and network analysis. Students in doubt about their background for enrollment in specific courses should discuss the matter with the Director of Graduate Studies. The M.S. program includes either a thesis or an oral comprehensive examination. A qualifying examination is required for the Ph.D. program. These examinations are intended to test both the breadth and depth of the student's understanding of electrical engineering. There is no foreign language requirement.

Professors

John Leslie Artley, D.Eng. (Johns Hopkins); Robert Blackburn Kerr, D.Eng. (Johns Hopkins); Peter N. Marinos, Ph.D. (North Carolina State); Loren W. Nolte, Ph.D. (Michigan); Harry Ashton Owen, Jr., Ph.D. (North Carolina State); Chairman; Theo Clyde Pilkington, Ph.D. (Duke); Frederick L. Thurstone, Ph.D. (North Carolina State); Thomas George Wilson, Sc.D. (Harvard).

Associate Professors

Herbert Hacker, Ph.D. (Michigan), Director of Graduate Studies; William Thomas Joines, Ph.D. (Duke); Paul P. Wang, Ph.D. (Ohio State).

Assistant Professor

Rhett Truesdale George, Ph.D. (Florida).

Courses of Instruction

203. Random Signals and Noise
204. Information Theory and Communication Systems
205. Signal Detection and Extraction Theory
208. Digital Computer Design
211. Solid State Theory
212. Solid State Materials
*213. Principles of Magnetism
*215. Semiconductor Physics
217. Lasers
221. Nonlinear Networks and Systems
222. Nonlinear Analysis
224. Integrated Electronics: Analog and Digital
225. Semiconductor Electric Circuits
227. Network Synthesis
242. Modern Control and Dynamic Systems
243. Advanced Linear Systems Theory
*259. Advanced Electric Energy Conversion
265. Advanced Topics in Electrical Engineering
266. Biofeedback Systems

271. Electromagnetic Theory
272. Applications of Electromagnetic Theory
297-298. Thesis Research
304. Estimation, Filtering, and Random Systems
305. Advanced Applications of Statistical Decision Theory
306. Adaptive Detection and Communication Systems
307. Advanced Digital Systems I
308. Advanced Digital Systems II
*313. Magnetic Processes in Materials
321. Nonlinear Magnetic and Semiconductor Circuits
324. Nonlinear Oscillations in Physical Systems
342. Optimal Control Theory
345. Stochastic Control Systems
361, 362. Electrical Engineering Seminar-Journal
*371. Advanced Electromagnetic Theory
*373. Selected Topics in Field Theory
399. Special Readings in Electrical Engineering

*Offered on demand

MECHANICAL ENGINEERING

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in mechanical engineering. Departmental programs of advanced study and research include control systems, dynamics and vibrations, fluid mechanics, heat and mass transport, mechanical design, metallurgy, polymer science, and thermodynamics. The mechanical engineering faculty cooperates with faculty members from a number of other departments and schools to establish interdisciplinary research projects and programs of study in the areas which include applied mechanics, biomechanics, biomedical materials, energy conversion, environmental quality and control, interaction of fields and materials, ocean engineering, systems engineering, and transportation systems.

The program includes the opportunity for experimental work as well as theoretical study. An increasing emphasis is placed upon developing the research ability of the student and relating the program to the evolving needs of modern engineering practice.

Professors

Jack Bartley Chaddock, Sc.D. (MIT), Chairman; Devendra P. Garg, Ph.D. (New York University); Charles Morgan Harman, Ph.D. (Wisconsin); Van Leslie Kenyon, Jr., M.M.E. (Delaware); L. Sigfred Linderoth, M.E. (Iowa State); John Nelson Macduff, M.M.E. (New York University); George Wilbur Pearsall, Sc.D. (MIT).

Associate Professors

Howard G. Clark, Ph.D. (Maryland); Franklin H. Cocks, Ph.D. (MIT); Ernest Elsevier, M.S.M.E. (Georgia Institute of Technology); Marion LaVerne Shepard, Ph.D. (Iowa State).

Assistant Professors

Gale Herbert Buzzard, Ph.D. (North Carolina State), Director of Graduate Studies; Bruce R. Munson, Ph.D. (Minnesota); Donald Wright, Ph.D. (Purdue).

Adjunct Professor

Verne L. Roberts, Ph.D. (Illinois).

Courses of Instruction

202. Theoretical Thermodynamics 210. Intermediate Dynamics 211. Theoretical and Applied Polymer Science 213. Advanced Materials Science 214. Environmental Factors in Materials Science 215. Failure Analysis and Prevention 221. Compressible Fluid Flow 222. Heat Transfer 226. Intermediate Fluid Mechanics 230. Modern Control and Dynamic Systems 231. Systems Response and Control 232. Nonlinear Analysis 233. Fluid Control Systems 235. Advanced Mechanical Vibrations 236. Engineering Acoustics and Noise Control 251. Refrigeration and Cryogenics 255. Energy Conversion	265. Advanced Topics in Mechanical Engineering 270. Theory of Lubrication and Bearing Design 280. Nuclear Reactor Power Cycles 300. Advanced Projects in Mechanical Engineering 302. Advanced Thermodynamics 309. Advanced Dynamics 311. Behavior of Crystalline Solids 322. Mechanics of Viscous Fluids 323. Convective Heat Transfer 324. Conduction and Radiation Heat Transfer 326. Hydrodynamic Stability 331. Nonlinear Control Systems 333. Seminar in Control Systems 335. Analytic Methods in Vibrations 372. Finite element Techniques in Design 399. Special Readings in Mechanical Engineering
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English

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the Ph.D. degree may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one modern foreign language for the A.M. degree and two languages, determined by the student's committee, for the Ph.D. degree.

Professors

Carl Anderson, Ph.D. (Pennsylvania); Louis J. Budd, Ph.D. (Wisconsin), Chairman; Edwin H. Cady, Ph.D. (Wisconsin); Bernard I. Duffey, Ph.D. (Ohio State); Oliver W. Ferguson, Ph.D. (Illinois); John L. Lievsay, Ph.D. (Washington); James B. Duke Professor of English; Holger O. V. Nygard, Ph.D. (California), Director of Graduate Studies; Dale B. J. Randall, Ph.D. (Pennsylvania); Edmund Reiss, Ph.D. (Harvard); Clyde de Loache Ryals, Ph.D. (Pennsylvania); Grover C. Smith, Ph.D. (Columbia); Arlin Turner, Ph.D. (Texas); George W. Williams, Ph.D. (Virginia).

Associate Professors

John Clubbe, Ph.D. (Columbia); Gerald E. Gerber, Ph.D. (Northwestern); Wallace Jackson, Ph.D. (Pennsylvania); Buford Jones, Ph.D. (Harvard); Elgin Mellow, Ph.D. (London); Gerald Monsman, Ph.D. (Johns Hopkins); Victor H. Strandberg, Ph.D. (Brown).

Assistant Professors

Ronald Richard Butters, Ph.D. (Iowa); A. Leigh DeNeef, Ph.D. (Pennsylvania State).

Courses of Instruction

207, 208. History of the English Language 209. Present-Day English 210. Old English Literary Tradition 212. Middle English Literary Tradition 215, 216. Chaucer 221. English Prose of the Sixteenth Century 222. English Nondramatic Poetry of the Sixteenth Century 223. Spenser	224. Shakespeare 225, 226. Tudor and Stuart Drama, 1500-1642 229, 230. English Literature of the Seventeenth Century 232. Milton 234. English Drama, 1642-1800 235, 236. The Eighteenth Century 241, 242. English Literature of the Early Nineteenth Century
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- 245, 246. English Literature of the Later Nineteenth Century
- 251, 252. English Literature of the Twentieth Century
- 263, 264. American Literature, 1800-1865
- 267, 268. American Literature, 1865-1910
- 270, 271. Southern Literature
- 275, 276. American Literature Since 1910
- 280. Introduction to Folklore
- 285. Literary Criticism
- 287. Recent Critical Thought
- 289. Literary Biography
- 310. Beowulf
- 312. Studies in Middle English Literature
- 315. Studies in Chaucer
- 318. Medieval Romances
- 320. Studies in Renaissance English Prose
- 324. Studies in Shakespeare
- 329. Studies in the Metaphysical Poets
- 330. Studies in Dryden and His Age
- 337. Studies in Swift
- 338. Samuel Johnson's Literary Criticism and Related Topics
- 339. The Eighteenth Century Novel
- 341. Studies in English Romanticism
- 343. Studies in the Critical and Philosophical Ideas of Coleridge and Carlyle
- 347. Studies in Victorian Poetry
- 348. Studies in Victorian Fiction
- 349. Studies in Nineteenth Century Non-fictional Prose
- 353. Studies in British Poetry of the Twentieth Century
- 361. Studies in a Major American Author of the Early Nineteenth Century
- 362. Studies in a Major American Author of the Later Nineteenth Century
- 364. Hawthorne and Melville
- 368. Studies in American Realistic Fiction
- 369. Studies in American Humor
- 376. Studies in Twentieth Century American Literature
- 380. The Traditional Ballad and Folksong
- 383. Textual Criticism
- 100. English for Foreign Students

Forestry

Major and minor work is offered in the natural and social aspects of forestry and related areas of natural resources leading to the A.M., M.S., and Ph.D. degrees. Work for these degrees may be pursued in the biological science areas of dendrology, wood anatomy, forest ecology, tree physiology, biochemistry, forest entomology, and forest pathology; in the environmental science areas of forest soils, meteorology, and hydrology; in resource economics; and in forest mensuration, biometry, and operations research. College graduates who have had specialized training in professional forestry or the related basic areas of the natural or social sciences will be considered for admission. Students will be restricted to the particular fields of specialization for which their academic background qualifies them. For information on professional training in forestry, the Bulletin of the School of Forestry should be consulted.

The specific degrees available in forestry and related natural resources through the Graduate School are: the Master of Arts (with or without a thesis), Master of Science (with a thesis), and the Doctor of Philosophy degrees. Students majoring in forestry may be required to demonstrate satisfactory knowledge of one or two foreign languages for the Doctor of Philosophy degree.

Professors

Roger Fabian Anderson, Ph.D. (Minnesota), Director of Graduate Studies; Robert Lloyd Barnes, Ph.D. (Duke); Ellwood Scott Harrar, Ph.D., Sc.D. (Syracuse); James B. Duke Professor of Wood Science; Henry Hellmers, Ph.D. (California at Berkeley); Kenneth Richard Knoerr, Ph.D. (Yale); Paul Jackson Kramer, Ph.D. (Ohio State); James B. Duke Professor of Botany; Jane Philpott, Ph.D. (State University of Iowa); Charles William Ralston, Ph.D. (Duke); Deon of the School of Forestry; William James Stambaugh, Ph.D. (Yale).

Associate Professor

David O. Yandle, Ph.D. (North Carolina State).

Adjunct Associate Professors

Edgar W. Clark, Ph.D. (California at Berkeley); Charles S. Hodges, Jr., Ph.D. (Georgia); Louis John Metz, Ph.D. (Duke); Fred M. Vukovich, Ph.D. (St. Louis).

Assistant Professors

Frank J. Convery, Ph.D. (State University of New York); James E. Wuenscher, Ph.D. (Wisconsin).

BIOLOGICAL SCIENCE

Courses of Instruction

201. Tree Physiology	321. Phytopathological Technique in Forestry
205. Tree Growth and Development	322. Microbiology of Forest Soils
206. Anatomy of Woody Plants	331. Toxicology of Insecticides
207. Chemistry of Woody Tissues	332. Ecology of Forest Insects
208. Physiology of Wood Formation	335. Entomological Research Techniques
222. Biology of Forest Insects and Diseases	341. Ecological Principles in Environmental Management
223. Forest Pathology	345, 346. Natural Resource Ecology—Environmental Management Seminar
225. Chemical Aspects of Forest Protection	347, 348. Natural Resource Ecology—Environmental Management Seminar
230. Forest Entomology	354. Quantitative Analysis of Ecological Environmental Systems
233. General Entomology	385. Seminar in Forest Protection
243. Natural Resource Ecology	398. Timbers of the World
277. Seminar in Natural Resource Allocation and Efficiency	
292. Microtechnique of Woody Tissue	
305. Forest Tree Biochemistry	

ENVIRONMENTAL SCIENCE

203. General Meteorology	306. Dynamics of Local Atmospheric Motion
204. Microclimatology	342. Hydrologic Processes
215. Air Pollution Meteorology	344. Micrometeorology
216. Watershed Hydrology	362. Forest Soil Physics
217. Environmental Instrumentation	364. Soil Classification and Mapping
261. Forest Soils	366. Forest Soil Fertility
304. Atmospheric Turbulence and Diffusion	

RESOURCE ECONOMICS AND POLICY

269. Resource Economics and Policy	273. Economics and Environmental Quality
270. Economics of Forestry	378. Seminar in Forest Economics

STATISTICS AND OPERATIONS RESEARCH

210. Analytical Techniques in Forest Utilization	258. Operations Research
250. Biometry	352. Theory and Applications of Linear Statistical Models
251. Theory and Methods for Sampling Biological Populations	353. Design and Analysis of Experiments
253. Computer Science in Natural Resources	354. Quantitative Analysis of Ecological and Environmental Systems

SPECIAL STUDIES AND RESEARCH

299. Special Studies in Forestry	357, 358. Research in Forestry
301, 302. Advanced Studies in Forestry	368. Field Seminars

The University Program in Genetics

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. It would be helpful if applicants for admission to the Graduate School indicated their interest in the genetics program at the time of application. Requests for information describing more completely the research interests of the staff, facilities, and special stipends and fellowships should be addressed to the Director, Genetics Program (Nanaline H. Duke Building, Room 151).

Professors

D. Bernard Amos, M.D. (Guys Hospital, London); Samson R. Gross, Ph.D. (Columbia). Director; Walter R. Guild, Ph.D. (Yale).

Associate Professors

Janis Antonovics, Ph.D. (Wales); John E. Boynton, Ph.D. (California at Davis); Nicholas Gillham, Ph.D. (Harvard); William N. Kelley, M.D. (Emory); Calvin L. Ward, Ph.D. (Texas); Robert E. Webster, Ph.D. (Duke).

Assistant Professors

Dwight H. Hall, Ph.D. (Purdue); Philip D. Harriman, Ph.D. (California at Berkeley); Nicholas Kredich, M.D. (Michigan); Frances E. Ward, Ph.D. (Brown).

Courses of Instruction

204. Introductory Genetics	285. Population Genetics
216. Molecular Genetics	286. Evolution
280. Principles of Genetics	288. The Cell in Development and Heredity
282. Experimental Genetics	336. Immunogenetics
284. Current Topics in Genetic Mechanisms	351-352. Genetics Seminar

Geology

The Department of Geology offers graduate work leading to the M.S. degree. An undergraduate degree in geology is not a prerequisite for graduate studies, but a student must have had or must take a summer field geology course (or equivalent experience), mineralogy, sedimentary rocks, stratigraphy, paleontology, and structural geology. In addition he must have had one year of college chemistry, one year of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide specialized training in the fields of oceanography, sedimentology, stratigraphy, paleontology, and low-temperature mineralogy. A thesis, but no language, is required for the M.S. degree.

Professors

S. Duncan Heron, Jr., Ph.D. (North Carolina), Chairman; Orrin H. Pilkey, Ph.D. (Florida State).

Associate Professors

William J. Furbish, M.S. (Wisconsin); George W. Lyons, Ph.D. (Wisconsin); Ronald D. Perkins, Ph.D. (Indiana), Director of Graduate Studies.

Lecturer

Susan R. Shuart, Ph.D. (Pennsylvania State).

Courses of Instruction

205. Geological Oceanography	241-242. Invertebrate Paleontology
206. Principles of Geological Oceanography	243-244. Micropaleontology
208. Shallow-Marine Geology	247. Paleoecology
211. Stratigraphic Principles and Applications	*300. Seminar in Oceanography
213. Sedimentology	305. Seminar in Continental Drift and Global Tectonics
214. Sediments in Thin Sections	*310. Seminar in Stratigraphy
222. Sedimentary Minerals	*312. Seminar in Sedimentology
*229. Economic Geology	*320. Seminar in Mineralogy
230. Principles of Structural Geology	*330. Seminar in Geochemistry
233. Geochemistry	*340. Seminar in Paleontology
	*350. Seminar in Geomathematics
	*371, 372. Advanced Topics in Geology

*Offered on demand.

Germanic Languages and Literature

The Department of Germanic Languages and Literature offers graduate work leading to the A.M. degree. Students who expect a major in German should have

had sufficient undergraduate courses in Germanic languages to enable them to proceed to more advanced work.

Students who wish to take courses in German as a related field should ordinarily have completed a third-year course (in exceptional cases, a second-year) of college German with acceptable grades.

Professors

Leland R. Phelps, Ph.D. (Ohio State), Chairman and Director of Graduate Studies; Herman Salinger, Ph.D. (Yale).

Associate Professor

Frank Borchardt, Ph.D. (Johns Hopkins).

Assistant Professors

A. Tilo Alt, Ph.D. (Texas); Richey Novak, Ph.D. (Johns Hopkins); Henry R. Stern, Ph.D. (Northwestern).

Courses of Instruction

201, 202. Goethe	*217. Renaissance and Reformation Literature
203, 204. Eighteenth Century	*218. The Teaching of German
*205, 206. Middle High German	*219. Applied Linguistics
*207, 208. German Romanticism	*232. Criticism and Literary Theory
209, 210. Kleist, Grillparzer, and Hebbel	*233. Advanced Composition
211, 212. Nineteenth Century Literature	*301. Gothic
213. Heinrich Heine	*316. The Austrian Novel from 1930 to the Present
214. The Twentieth Century	321, 322. Germanic Seminar
*215. Seventeenth Century Literature	
216. History of the German Language	

*Offered on demand.

Health Administration

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-one month academic program that leads to the M.H.A. degree. The academic portion is composed of five continuous semesters of graduate work of which 36 units are within the department, 39 units are in other departments of the Graduate School (30 of these units are in courses offered through the Graduate School of Business Administration).

Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests. For students without previous administrative experience, the residency should be considered an integral part of the M.H.A. program. Admission to this program is based upon suitability of the candidate to assume leadership roles in the organization and management of the delivery of health services, as well as on capability for graduate study. As requirements for participation differ somewhat from the basic admission requirements of the Graduate School, interested individuals should obtain complete information about the program directly from the Chairman.

Professor

Stuart M. Sessions, M.D. (Medical College of Virginia).

Associate Professors

Boi Jon Jaeger, Ph.D. (Duke), Chairman; Wilma A. Minnear, M.S. (Case Western Reserve); Louis E. Swanson, A.B. (Hamline).

Assistant Professor

Donald S. Smith, II, M.H.A. (Minnesota), Director of Graduate Studies.

Adjunct Professor

John T. Gentry, M.D., M.P.H. (Harvard).

Adjunct Associate Professor

Elizabeth J. Coulter, Ph.D. (Radcliffe).

Adjunct Assistant Professors

Arnold D. Kaluzny, Ph.D. (Michigan); Richard H. Peck, M.H.A. (Duke).

Lecturer

Jeff H. Steinert.

Courses of Instruction

201. The Health System and Its Environment	346. Community Health Services
312. Comparative Health Systems	348. Legal and Regulatory Constraints on Health Services
322. Public Policy and Health Care	350. The Administrative Residency
324. Institutional Health Services	360. Seminar in Health Administration
329-339-349. The Clerkship	371, 372. Directed Research
335. Ambulatory Health Services	380. Administrative Residency

History

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. The candidate for the A.M. degree must have a reading knowledge of at least one ancient or modern language related to this program of study and have completed successfully either a research paper (approximately fifty to sixty documented pages) or two related, chapter-length papers (approximately twenty-five to thirty documented pages each), usually the product of a year's seminar or two semester-courses. The paper or papers must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and approved by April 15; those anticipating a September degree must have their papers read and approved by August 15.

A candidate for the degree of Doctor of Philosophy is required to prepare himself for examination in four fields. Three shall ordinarily be history. The choice of fields is determined in consultation with the student's supervisor and the Director of Graduate Studies. The department offers graduate instruction in the fields of Africa, Afro-American history, ancient history, medieval and early modern Europe, modern Europe, American history, Britain and the Commonwealth, imperial Russia, modern Russia, Latin America, South Asia, traditional China, modern China, traditional Japan, modern Japan, military history, history of science, and history of medicine. The candidate for the Ph.D. degree usually must have a reading knowledge of two foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative would ordinarily take the form of successfully completed formal training in an auxiliary discipline (such as statistics or a course in one of the other social sciences with an emphasis upon methodology) of from 3 to 6 units, or their equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

Students may receive credit for either semester of a hyphenated course without

taking the other semester if they obtain written permission from the instructor and the Director of Graduate Studies.

Professors

John R. Alden, Ph.D. (Michigan); James B. Duke Professor of History; Joel Colton, Ph.D. (Columbia); Chaimon; Robert F. Durden, Ph.D. (Princeton); Arthur B. Ferguson, Ph.D. (Cornell); Irving B. Holley, Jr., Ph.D. (Yale); Frederic Hollyday, Ph.D. (Duke); Warren Lerner, Ph.D. (Columbia); John F. Oates, Ph.D. (Yale); Harold T. Parker, Ph.D. (Chicago); Richard A. Preston, Ph.D. (Yale); William K. Boyd Professor of History; Theodore Ropp, Ph.D. (Harvard); Anne Firor Scott, Ph.D. (Radcliffe); William E. Scott, Ph.D. (Yale); Bernard S. Silberman, Ph.D. (Michigan); John J. TePaske, Ph.D. (Duke); Richard L. Watson, Ph.D. (Yale); Charles Young, Ph.D. (Cornell). Director of Graduate Studies.

Associate Professors

Frances Dorothy Acomb, Ph.D. (Chicago); Gert H. Brieger, M.D. (California at Los Angeles), Ph.D. (Johns Hopkins); John Cell, Ph.D. (Duke); Calvin D. Davis, Ph.D. (Indiana); Gerald Hartwig, Ph.D. (Indiana); Seymour Mauskopf, Ph.D. (Princeton); Sydney Nathans, Ph.D. (Johns Hopkins); Ronald Witt, Ph.D. (Harvard).

Assistant Professors

Charles W. Bergquist, Ph.D. (Stanford); Philip B. Calkins, Ph.D. (Chicago); William Chafe, Ph.D. (Columbia); Arif Dirlik, Ph.D. (Rochester); Raymond Gavins, Ph.D. (Virginia); Lawrence C. Goodwyn, Ph.D. (Texas); Martin Miller, Ph.D. (Chicago).

Courses of Instruction

201-202. History of Russia, 1801-1917
207-208. Urban History of the United States
209-210. Selected Topics in Afro-American History, 1619-Present
212. Recent Interpretations of United States History
215-216. The Diplomatic History of the United States
221-222. Problems in the History of Late Medieval and Early Modern Europe
223, 224. The Old Regime, the Enlightenment, and the French Revolution
227-228. Recent U.S. History: Major Political and Social Movements
229. Recent Interpretations of Modern European History
231, 232. Problems in the History of Spain and the Spanish Empire
237, 238. Europe in the Middle Ages, 395-1500
240. Aspects of Traditional and Modern African Culture
241-242. Modernization and Revolution in China
247. History of Modern India and Pakistan, 1707-1857
248. History of Modern India and Pakistan, 1857-Present
249-250. Social and Intellectual History of the United States
253-254. Modern European Intellectual History
255-256. Problems in African History
261-262. Problems in Soviet History
263-264. American Colonial History and the Revolution, 1607-1789
265, 266. Problems in Modern Latin American History
267-268. From Medieval to Early Modern England
269-270. British History, Seventeenth Century to the Present
273, 274. Topics in the History of Science
275, 276. Central Europe, 1849-1914
277, 278. The Era of the Civil War in the United States and Its Aftermath, 1820-1900
279. Oral History
280. Historiography
281, 282. Development of Modern Medicine
283-284. Political and Social Change in the United States, 1789-1860
287-288. History of Modern Japan
296. Canada from the French Settlement to the Present
297. The British Empire in the Nineteenth Century (from 1783)
298. The Commonwealth in the Twentieth Century
305-306. Seminar in British History
307-308. Seminar in United States History
309-310. Seminar in American Colonial and Revolutionary History
317-318. Seminar in the History of Western Europe
337-338. Seminar in Medieval History
343-344. Seminar in the History of American Foreign Relations
347-348. Seminar in Modern India
353-354. Seminar on the Second British Empire and the Commonwealth of Nations
361-362. Seminar in the History of Russia
371-372. Research Seminars
401. Seminar on the British Commonwealth

351.1-352.1. Military History	351.47-352.47. Diplomatic History of the United States
351.2-352.2. Modern European Intellectual and Cultural History	351.51-352.51. Hispanic America
351.10-352.10. Medieval Europe	351.60-352.60. Soviet History
351.15-352.15. The English Renaissance	351.65-352.65. Modernization and Revolution in China
351.25-352.25. Central Europe, 1849-1914	351.70-352.70. Modern South Asia
351.30-352.30. European Diplomatic History Since 1870	351.74-352.74. American Colonial History and the Revolution
351.31-352.31. Twentieth Century Europe	312. Seminar in the Teaching of History in College
351.40-352.40. City and Frontier in United States History	314. Historical and Social Science Methodology
351.45-352.45. Reform and Politics in Nineteenth Century America	
351.46-352.46. Twentieth Century United States to 1941	

The University Program in Marine Sciences

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are Botany, Chemistry, Geology, and Zoology.

A graduate student working in the marine sciences will take his degree under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of his training he will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of his course work and preliminary examination (for doctoral candidates) he may, with approval of his major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.

Applications for summer courses at the Laboratory should be addressed to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the Duke University Marine Laboratory Bulletin. The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received before March 10.

The following courses are offered during the summer at Beaufort. See the Duke University Marine Laboratory Bulletin for the current schedule of courses.

Professors

Cazlyn Green Bookhout, Ph.D. (Duke); John Costlow, Ph.D. (Duke), Director; Terry W. Johnson, Jr., Ph.D. (Michigan); *Orrin Pilkey, Ph.D. (Florida State).

Associate Professors

Richard T. Barber, Ph.D. (Stanford); *Richard B. Searles, Ph.D. (California at Berkeley).

Assistant Professors

Roger W. Baier, Ph.D. (Washington); William F. Blankley, Ph.D. (California at San Diego); Richard B. Forward, Ph.D. (California at Santa Barbara); John Gutknecht, Ph.D. (North Carolina); J. Bolling Sullivan, Ph.D. (Texas); John Sutherland, Ph.D. (California at Berkeley).

*In residence at the Marine Laboratory during the summer only.

Courses of Instruction

S202. Introduction to Comparative Behavior	211. Marine Phycology
203. Marine Ecology	212. Membrane Physiology and Osmoregulation
204. Introductory Marine Microbiology	214. Biological Oceanography
205. Geological Oceanography	

240. Chemical Oceanography
 250. Physiological Ecology of Marine Animals
 274. Marine Invertebrate Zoology
 276. Comparative and Evolutionary Biochemistry
 S277. Endocrinology of Marine Animals
 S278. Invertebrate Embryology

Mathematics

Graduate work in the Department of Mathematics is offered leading to the M.S., A.M., and Ph.D. degrees. The student, in his undergraduate work, must have had courses in differential and integral calculus, and at least 6 semester hours of other courses in mathematics on the junior or senior level.

The department offers a program in applied statistics with a minor in computer science leading to the M.S. degree. The program consists of 24 units of graded course work plus a thesis project involving the use of the computer.

All A.M. and Ph.D. candidates are required to pass a comprehensive examination in the areas of algebra, analysis, and topology. Students will usually take the comprehensive examination after completing their first year of graduate study and just prior to the start of their second year.

The A.M. degree with a major in mathematics is awarded primarily on the basis of scholarship. It requires 30 units of graded course work in addition to the comprehensive examination. A thesis may be substituted for 6 units of course work only in unusual circumstances.

The Ph.D. degree in mathematics is awarded upon the demonstration of ability and training in research. The original dissertation, therefore, is the most important of the formal requirements for the degree.

All A.M. and Ph.D. candidates are expected to participate in a proseminar during their first year of graduate study. The purpose is to provide experience in organizing and presenting material to their peers.

Since a reading knowledge of French, German, and Russian is highly desirable for a student of mathematics, the Ph.D. candidate should satisfy the requirement in two of these languages as early as possible. The department offers departmentally administered language examinations as an alternative to the ETS examinations.

Professors

Leonard Carlitz, Ph.D. (Pennsylvania); James B. Duke Professor of Mathematics; Francis George Dressel, Ph.D. (Duke); Francis Joseph Murray, Ph.D. (Columbia); Michael C. Reed, Ph.D. (Stanford); Joseph Robert Shoenfield, Ph.D. (Michigan); Seth L. Warner, Ph.D. (Harvard), Chairman; Morris Weisfeld, Ph.D. (Yale).

Associate Professors

Donald Stanley Burdick, Ph.D. (Princeton), Director of Graduate Studies; Richard Earl Hodel, Ph.D. (Duke); Joseph W. Kitchen, Jr., Ph.D. (Harvard); David P. Kraines, Ph.D. (California at Berkeley); Lawrence Carlton Moore, Jr., Ph.D. (California Institute of Technology); Richard A. Scoville, Ph.D. (Yale); David A. Smith, Ph.D. (Yale); Olaf Patrick Stackelberg, Ph.D. (Minnesota).

Assistant Professors

Jack A. Lees, Ph.D. (Chicago); Barry MacKichan, Ph.D. (Stanford); William Michael O'Fallon, Ph.D. (North Carolina); Kai-Tac Wong, Ph.D. (Princeton).

Courses of Instruction

204. Geometry for Teachers	*229, 230. Algebraic Numbers
206. Introduction to Stochastic Processes	*234. Sample Designs
207, 208. Introduction to Algebraic Structures	235, 236. Algebra
217, 218. Intermediate Analysis	244. Analysis of Variance
221, 222. Numerical Analysis	*245, 246. Combinatorial Analysis
223. Numerical Analysis III	*247, 248. Arithmetic of Polynomials
*227, 228. Theory of Numbers	256. Foundations of Applied Mathematics
*Offered on demand.	260. Design of Experiments
	*262. Non-Parametric Statistics

- 265, 266. Homological Algebra and its Applications
- 269, 270. Recursive Function Theory
- 271, 272. Introductory Topology
- *273, 274. Algebraic Topology
- *275, 276. Probability
- 284. Least-Squares Analysis of Linear Models
- 285. Applied Mathematical Methods I
- 286. Applied Mathematical Methods II
- *287, 288. Foundations of Mathematics
- 290. Stochastic Processes
- 291, 292. Analysis I, II
- 293. Multivariate Statistics
- *295. Mathematical Foundations of Statistical Inference
- *297, 298. Axiomatic Set Theory
- *303, 304. Advanced Theory of Numbers
- 325, 326. Analysis III, IV
- *327, 328. Partial Differential Equations
- *329, 330. Theory of Distributions
- *331, 332. Advanced Topics in Complex Variables
- *333, 334. Analytic Theory of Numbers
- *335, 336. Topics in Algebra
- *343, 344. Differential Equations
- *353, 354. Topics in Analysis
- 361, 362. Hilbert Space
- *371, 372. Dimension Theory
- *377, 378. Topics in Topology
- *383, 384. Lie Groups and Algebras
- *392. Nuclear Spaces
- *393. Topological Groups
- *394. Topological Rings
- *395, 396. Topological Algebra
- *397, 398. Seminar in Algebra and Number Theory

*Offered on demand.

Medieval and Renaissance Studies

A graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. A participating student is based in one of the regular departments and fulfills the Ph.D. requirements for that discipline, and in addition he takes a program of electives which will aid his interdisciplinary competence in the medieval or Renaissance area (or some intellectually valid combination of the two). Such a program includes a choice from the fields of art history, language and literature, history, philosophy, and religion. In other words, a student is enabled to minor in medieval and Renaissance studies.

Inquiries should be addressed to the Chairman of the Duke University Committee on Medieval and Renaissance Studies, P.O. Box 466, Duke Station.

ART

Courses of Instruction

233. Early Medieval Architecture	251-252. Research
234. Romanesque Sculpture	253. Studies in Italian Renaissance
237. French Renaissance Art	Sculpture
238. Sienese Painting	255, 256. Iconological Problems
248. Florentine Painting during the Renaissance	

LATIN

221. Medieval Latin I	305. Latin Seminar V
222. Medieval Latin II	306. Latin Seminar VI
225. Palaeography	312. Proseminar in Latin Palaeography

CLASSICAL STUDIES

327. Seminar in Byzantine History

ENGLISH

207, 208. History of the English Language	222. English Nondramatic Poetry of the Sixteenth Century
210. Old English Literary Tradition	223. Spenser
212. Middle English Literary Tradition	224. Shakespeare
215, 216. Chaucer	225, 226. Tudor and Stuart Drama, 1500-1642
221. English Prose of the Sixteenth Century	

229. English Literature of the Seventeenth Century 232. Milton 310. Beowulf 312. Studies in Middle English Literature 315. Studies in Chaucer 318. Medieval Romances	320. Studies in Renaissance English Prose 324. Studies in Shakespeare 325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries 329. Studies in the Metaphysical Poets 383. Textual Criticism
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GERMAN

205, 206. Middle High German 215. Seventeenth Century Literature 216. History of the German Language	217. Renaissance and Reformation Literature
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HISTORY

221-222. Problems in the History of Late Medieval and Early Modern Europe 237-238. Europe in the Middle Ages. 395-1500 267-268. From Medieval to Early Modern England	305-306. Seminar in British History 337-338. Seminar in Medieval History 351.10-352.10 Medieval Europe 351.15-352.15 The English Renaissance
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PHILOSOPHY

218. Medieval Philosophy

RELIGION

236. Luther and the Reformation in Germany 241. Problems in Reformation Theology 251. The Counter-Reformation and the Development of Catholic Dogma 334. Church Reformers and Christian Unity	336. Christian Mysticism in the Middle Ages 338. Calvin and the Reformation in Switzerland 339. The Radical Reformation 344. Zwingli and the Origins of Reformed Theology
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FRENCH

213, 214. French Literature of the Seventeenth Century 219. Old French Literature 224. History of the French Language	225. French Prose of the Sixteenth Century 226. French Poetry of the Sixteenth Century 311, 312. French Seminar (Medieval and Renaissance Topics)
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ITALIAN

284. Dante	288. The Renaissance
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SPANISH

251. The Origins of the Spanish Novel 252. Spanish Lyric Poetry Before 1700 253. The Origins of the Spanish Theater 257. Old Spanish 258. Old Spanish Literature	265. Golden Age Literature: Cervantes 266. Golden Age Literature: The Drama 321, 322. Hispanic Seminar (Medieval and Renaissance Topics)
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Microbiology and Immunology

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

Professors

D. Bernard Amos, M.D. (Guys Hospital, London); James B. Duke Professor of Immunology; Joseph Willis Beard, M.D. (Vanderbilt); James B. Duke Professor of Virology; Richard O. Burns, Ph.D. (Illinois); Norman F. Conant, Ph.D. (Harvard); James B. Duke Professor of Microbiology; Eugene D. Day, Ph.D. (Delaware); Wolfgang Karl Joklik, D.Phil. (Oxford); James B. Duke Professor of Microbiology and Immunology and Chairman of the Department; Richard S. Metzgar, Ph.D. (Buffalo); Suydam Osterhout, M.D., (Duke), Ph.D. (Rockefeller Institute); Hilda Pope Willett, Ph.D. (Duke), Director of Graduate Studies.

Associate Professors

C. Edward Buckley, III, M.D. (Duke); Rebecca H. Buckley, M.D. (North Carolina); Wendell Rosse, M.D. (Chicago); H. F. Seigler, M.D. (North Carolina); Frances E. Ward, Ph.D. (Brown); Robert W. Wheat, Ph.D. (Washington); Hans Zweerink, Ph.D. (Cornell).

Assistant Professors

Dani P. Bolognesi, Ph.D. (Duke); Jeffrey R. Dawson, Ph.D. (Case Western Reserve); Peter K. Lauf, Ph.D. (Freiburg); Jack L. Nichols, Ph.D. (Alberta); David W. Scott, Ph.D. (Yale); Ralph E. Smith, Ph.D. (Denver); Thomas C. Vanaman, Ph.D. (Duke).

Courses of Instruction

215. Bacteriophage: Structure and Function	311. Immunochemistry
219. Molecular and Cellular Basis of Development	313. Immunohematology
219S. Optional Seminar Offered in Conjunction with Microbiology 219	323. Readings in Bacteriology and Immunology
221. Medical Microbiology	325. Medical Mycology
233. Microbiology	330. Medical Immunology
252. General Animal Virology and Viral Oncology	331, 332. Microbiology-Immunology Seminar
282. Molecular Microbiology	336. Immunogenetics
291, 292. Immunology I and II	420. Cellular Immunophysiology

Pathology

The Department of Pathology offers graduate work leading to the M.S. and Ph.D. degrees with areas of specialization such as subcellular and molecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of modern research techniques. Students will be required to take such courses as are necessary to obtain this foundation, and as are best adapted to areas of specialty and research. Further information including brochures giving details of departmental facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

Professors

Bernard F. Fetter, M.D. (Duke); Donald B. Hackel, M.D. (Harvard); William W. Johnston, M.D. (Duke); Thomas D. Kinney, M.D. (Duke), Chairman, R. J. Reynolds Tobacco Company Professor of Medical Education; Gordon K. Klintworth, M.D., Ph.D. (Witwatersrand); Joachim R. Sommer, M.D. (Munich), Director of Graduate Studies; Philip Pratt, M.D. (Johns Hopkins); F. Stephen Vogel, M.D. (Western Reserve); Benjamin Wittels, M.D. (Minnesota).

Associate Professors

William D. Bradford, M.D. (Western Reserve); Jane G. Elchlepp, Ph.D. (Iowa), M.D. (Chicago); Norman B. Ratliff, M.D. (Duke).

Assistant Professors

Dolph O. Adams, M.D., Ph.D. (North Carolina); Darrell D. Bigner, M.D., Ph.D. (Duke); Edward H. Bossen, M.D. (Duke); Charles Daniels, M.D., Ph.D. (Duke); Frank C. Dorsey, Ph.D.

(Duke); Doyle G. Graham, M.D., Ph.D. (Duke); Hal Hawkins, M.D., Ph.D. (Duke); Hugo Jauregui, M.D., Ph.D. (Duke); John D. Shelburne, M.D., Ph.D. (Duke); George Spooner, Ph.D. (North Carolina); Craig Tisher, M.D. (Washington University); James W. Wilson, Ph.D. (Kentucky). M.D. (Duke).

Courses of Instruction

219. Molecular and Cellular Basis of Development	361, 362. Autopsy Pathology
219S. Seminar	364. Systemic Pathology
250. General Pathology	367, 368. Special Topics in Pathology
251. Laboratory Course in General Pathology	369. Ophthalmic Pathology
325. Cardiovascular Pathology	370. Developmental Pathology and Teratology
352. Basic Problems in Chemical Pathology	373. Cytopathology
353. Advanced Neuropathology	374. Pulmonary Pathology and Post-mortem Pathophysiology
355, 356. Graduate Seminar in Pathology	375. Fundamentals of Electron Microscopy
357. Research in Pathology	377. Pathology of the Kidney
358. Cellular and Subcellular Pathology	378. Immunopathology
360. Histochemistry	379. Pathology of Virus Infections

Philosophy

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophical analysis, ethics, aesthetics, political philosophy, and philosophy of law.

Individual programs of study are developed for each student. The following requirements, however, are fundamental: (1) In February of their first year new graduate students are required to take two or three qualifying examinations, diagnostic in purpose. One examination is in the history of philosophy, ancient and modern; a second examines his ability to deal critically and systematically with some basic philosophical topic; a third examination, in logic, is required of anyone who has not taken a graduate-level logic course during his first term. (2) The preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for the A.M. or the Ph.D. and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School for the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree, or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. No student may take his preliminary examination until he has demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

Professors

W. H. Dray, D.Phil. (Oxford); Glenn Robert Negley, Ph.D. (Chicago); William Bernard Peach, Ph.D. (Harvard); Paul Welsh, Ph.D. (Cornell), Choirmon.

Associate Professors

Edward P. Mahoney, Ph.D. (Columbia), Director of Graduate Studies; George W. Roberts, Ph.D. (Cambridge); David H. Sanford, Ph.D. (Cornell).

Assistant Professors

Richard E. Aquila, Ph.D. (Northwestern); Theodore Benditt, Ph.D. (Pittsburgh); David J. Ross, Ph.D. (Stanford).

Courses of Instruction

- 202. Aesthetics: The Philosophy of Art
- 203. Contemporary Ethical Theories
- 204. Philosophy of Law
- 205. Philosophy of History
- 206. Topics in Ethical Theory
- 208. Political Values
- 211. Plato
- 217. Aristotle
- 218. Medieval Philosophy
- 225. British Empiricism
- 227. Continental Rationalism
- 228. Recent and Contemporary Philosophy
- 230. The Meaning of Religious Language
- 231. Kant's Critique of Pure Reason
- 232. Recent and Continental Philosophy
- 233. Methodology of the Empirical Sciences
- 234. Problems in the Philosophy of Science
- 241. Symbolic Logic
- 251. Epistemology
- 252. Metaphysics
- 253. Philosophy of Mind
- 254. Philosophy of Religion
- 255. Philosophy of Action
- 260. Wittgenstein
- 287, 288. Foundations of Mathematics
- 291, 292. Seminar in Special Fields of Philosophy
- 331, 332. Seminar in Special Fields of Philosophy

Physical Therapy

The Department of Physical Therapy offers a basic professional program leading to the M.S. degree. To be eligible for admission to the program, applicants must have obtained a baccalaureate degree and have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and mathematics. In the first year of the curriculum students are required to take Anatomy 300 and Physiology 200. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3247, Duke University Medical Center.

Associate Professor

Eleanor F. Branch, Ph.D. (Duke).

Assistant Professors

Jane S. Mathews, M.P.H. (North Carolina), Acting Chairman and Director of Graduate Studies; Elia E. Villanueva, M.A. (Duke).

Courses of Instruction

- 201, 202. Seminar in Physical Therapy
- 217. Physical Therapy Dynamics I
- 218. Physical Therapy Dynamics II
- 220. Physical Therapy Dynamics III
- 230. Physical Evaluation and Instrumentation
- 234. Introductory Pathology
- 236. Medical Sciences
- 238. Introduction to Health Service Systems
- 242. Directed Clinical Experience in Physical Therapy I
- 243. Directed Clinical Experience in Physical Therapy II
- 301. Introduction to Scientific Inquiry
- 315. Curriculum Development
- 316. Directed Teaching in Physical Therapy
- 320. Sensorimotor Mechanism Related to Rehabilitation
- 322. Case Conferences in Rehabilitation
- 332. Administration of Physical Therapy Services
- 341-342. Advanced Seminar—Selected Problems
- 350. Research

Physics

The Department of Physics offers graduate work for students wishing to earn the A.M. or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields of high current interest, in which research is being done by students, faculty, and staff.

With the help of faculty advisers, each student selects a course program to fit his needs, including work in a related field, usually mathematics or chemistry. Students are encouraged to begin research work early in their career.

The department does not ordinarily accept students for work toward the A.M. degree only, and students making good progress are advised to work directly for the Ph.D. The option of taking the A.M. without thesis is available, with the approval of a departmental committee.

A reading knowledge of one language, usually chosen from French, German, or Russian, is required for the Ph.D. degree.

Professors

L.C. Biedenharn, Jr., Ph.D. (MIT); Edward G. Bilpuch, Ph.D. (North Carolina); Henry A. Fairbank, Ph.D. (Yale); Chirmon; Walter Gordy, Ph.D. (North Carolina), LL.D., D.H.C., James B. Duke Professor of Physics; Eugene Greuling, Ph.D. (Indiana); Harold W. Lewis, Ph.D. (Duke); Horst Meyer, D.Sc. (Geneva); Henry W. Newson, Ph.D. (Chicago); James B. Duke Professor of Physics; Hugh G. Robinson, Ph.D. (Duke); William D. Walker, Ph.D. (Cornell).

Associate Professors

Ron Y. Cusson, Ph.D. (California Institute of Technology); Lawrence E. Evans, Ph.D. (Johns Hopkins), Director of Graduate Studies; Lloyd R. Fortney, Ph.D. (Wisconsin); Moo-Young Han, Ph.D. (Rochester); Russell Roberson, Ph.D. (Johns Hopkins); Richard L. Walter, Ph.D. (Notre Dame).

Assistant Professors

Frank C. DeLucia, Ph.D. (Duke); Alfred T. Goshaw, Ph.D. (Wisconsin); James S. Loos, Ph.D. (Illinois); Eberhard Karl Riedel, Ph.D. (Munich); John Sykes, Ph.D. (Birmingham).

Adjunct Professors

Herman Robl, Ph.D. (Vienna); Katherine Way, Ph.D. (North Carolina).

Courses of Instruction

211, 212. Advanced Modern Physics	312. Phase Transitions and Critical Phenomena
215. Introduction to Quantum Mechanics	316. Principles of Quantum Theory
217, 218. Advanced Physics Laboratory and Seminar	317. Intermediate Quantum Theory
220. Electronics	318. Electromagnetic Field Theory
223. Electricity and Magnetism	*330. Nuclear Structure Theory
282. Mechanics of Continuous Media	*331. Microwave Radiation
302. Advanced Mechanics	*335. Microwave Spectroscopy
303. Statistical Mechanics	*341. Advanced Topics in Quantum Theory
*304. Advanced Topics in Statistical Mechanics	*342. Theory of Elementary Particles
305. Introduction to Nuclear Physics	*343. Nuclear Physics
*306. Low Temperature Physics	*344. Advanced Nuclear Physics
308. Introduction to High Energy Physics	*345. High Energy Physics
309. Solid State Physics I	*346. Topics in Theoretical Physics
*310. Solid State Physics II	351, 352. Seminar
	397, 398. Low Temperature and Solid State Seminar

*Offered on demand.

Physiology and Pharmacology

The Department of Physiology and Pharmacology offers graduate work leading to the Ph.D. degree. Before undertaking this program a student should have a strong background in basic sciences including course work in mathematics, biology, physics, and chemistry through physical chemistry. Undergraduates with this background may have majors in any of the following areas: biology, chemistry, physics, or engineering. There is no foreign language requirement. All graduate students are required to take the introductory courses in both physiology and pharmacology. A brochure which describes the program of study, facilities, and the research activities of the staff is available from the Director of Graduate Studies.

Professors

F. Bernheim, Ph.D. (Cambridge). James B. Duke Professor of Pharmacology; J. J. Blum,

Ph.D. (Chicago); George H. Hitchings, Ph.D. (Harvard); F. Jobsis, Ph.D. (Michigan); E. A. Johnson, M.D. (Sheffield, England); L. Lack, Ph.D. (Columbia); Robert Arthur Maxwell, Ph.D. (Princeton); J. W. Moore, Ph.D. (Virginia); T. Narahashi, Ph.D. (Toyko); Charles Adams Nichol, Ph.D. (Wisconsin); E. M. Renkin, Ph.D. (Harvard); S. Schanberg, Ph.D., M.D. (Yale); G. Somjen, M.D. (New Zealand); D. C. Tosteson, M.D. (Harvard). Chairman, James B. Duke Professor of Physiology.

Associate Professors

R. E. Fellows, Jr., M.D. (McGill), Ph.D. (Duke); Johannes A. Kylstra, M.D., Ph.D. (Leiden); P. K. Lauf, M.D. (Freiburg); Daniel B. Menzel, Ph.D. (California at Berkeley); T. J. McManus, M.D. (Boston). Director of Graduate Studies; A. Ottolenghi, M.D. (Pavia); G. M. Padilla, Ph.D. (California at Los Angeles); Herbert S. Posner, Ph.D. (George Washington); J. V. Salzano, Ph.D. (Iowa); M. Wolbarsht, Ph.D. (Johns Hopkins).

Assistant Professors

N. C. Anderson, Ph.D. (Purdue); Howard L. Elford, Ph.D. (Cornell); Joseph C. Greenfield, M.D. (Emory); Robert Burns Gunn, M.D. (Harvard); J. Gutknecht, Ph.D. (North Carolina); Gary Kirk, Ph.D. (Yale); J. Mailen Kootsey, Ph.D. (Brown); Harold E. Lebovitz, M.D. (Pittsburgh); M. Lieberman, Ph.D. (State University of New York at Brooklyn); Lazaro J. Mandel, Ph.D. (Pennsylvania); L.M. Mendell, Ph.D. (MIT); E. Mills, Ph.D. (Columbia); Gerald Martin Rosen, Ph.D. (Clarkson); Myron Rosenthal, Ph.D. (Duke); C. W. Schomberg, Ph.D. (Purdue); James M. Schooler, Ph.D. (Wisconsin); Theodore Alan Slotkin, Ph.D. (Rochester); H. C. Wachtel, Ph.D. (New York University).

Courses of Instruction

- 200. Introduction to the Physiology of Man
- 202. Introduction to Physiology
- 203. Advanced Physiology
- 208. Respiratory System in Health and Disease
- 210, 211. Individual Study and Research
- 212. Membrane Physiology and Osmoregulation
- 215. Topics in Developmental Physiology and Pharmacology
- 216. Contractile Processes
- 217. Membrane Transport in Physiology and Pharmacology
- 230. Molecular and Cellular Basis of Development
- 230S. Optional seminar offered in conjunction with Physiology 230.
- 250. Pharmacology: Mode of Action of Drugs
- 252. Cellular and Chemical Pharmacology
- 254. Mammalian Toxicology
- 256. Human Nutrition
- 280. Student Seminar in Physiology and Pharmacology
- 321. Gastrointestinal and Renal Physiology
- 325. Microcirculation: Rheology and Transport
- 330. Pharmacological Basis of Clinical Medicine
- 331. Laboratory Methods in Pharmacology
- 334. Pharmacodynamics
- 362. Current Topics in Cardiac Muscle Physiology
- 372. Research in Physiology and Pharmacology
- 383. Physiological Instrumentation
- 393. Integrative and Clinical Neurophysiology and Neuropharmacology
- 395. Biochemical Pharmacology
- 401. Metabolic and Developmental Physiology and Pharmacology
- 414. Analysis of Physiological Systems
- 416. Neuronal Physiology and Pharmacology
- 417. Cellular Endocrinology
- 418. Reproductive Biology
- 420. Cellular Immunophysiology
- 422. Advanced Seminar in Endocrinology and Reproductive Physiology I
- 423. Advanced Seminar in Endocrinology and Reproductive Physiology II

Political Science

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is usually expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government.

Fields in which instruction is at present offered are American government and

politics (including constitutional law, public administration, the legislative and judicial processes, and state and local government); comparative government and politics (including Western Europe, Southern Asia, Latin America, Africa, the Soviet Union, and the Commonwealth); political theory; international relations (including international law and international organization); and empirical theory and methodology.

Candidates for the master's degree are required to show proficiency in one modern foreign language and to submit either a thesis or thesis equivalent. The latter option is open only to students going on for the Ph.D. The thesis equivalent is defined as a major research paper substituted for the thesis on recommendation of the student's supervisor and with the approval of the Director of Graduate Studies.

The candidate for the degree of Doctor of Philosophy in political science must elect four fields, at least three of which must be selected from the fields enumerated above and one of which must be in a related department. He must also demonstrate a reading knowledge of two foreign languages which have been approved by the professor who supervises his dissertation, or he must demonstrate proficiency in one such foreign language and in the use of statistics.

Professors

M. Margaret Ball, Ph.D. (Stanford); James David Barber, Ph.D. (Yale), Chairman; Ralph Braibanti, Ph.D. (Syracuse); James B. Duke Professor of Political Science; Frederic N. Cleaveland, Ph.D. (Princeton); Robert Taylor Cole, Ph.D. (Harvard); James B. Duke Professor of Political Science; Samuel DuBois Cook, Ph.D. (Ohio State); Kazimierz Grzybowski, S.J.D. (Harvard); Hugh Marshall Hall, Jr., Ph.D. (Texas); John Hamilton Hallowell, Ph.D. (Princeton); Jerry F. Hough, Ph.D. (Harvard); Allan Kornberg, Ph.D. (Michigan); Richard H. Leach, Ph.D. (Princeton).

Visiting Professor

Norman D. Palmer, Ph.D. (Yale).

Associate Professors

Peter Fish, Ph.D. (Johns Hopkins), Director of Graduate Studies; Sheridan Johns, III, Ph.D. (Harvard); David Paletz, Ph.D. (California at Los Angeles); David E. Price, B.D., Ph.D. (Yale).

Assistant Professors

Albert Eldridge, Ph.D. (Kentucky); Willis F. Hawley, Ph.D. (California at Berkeley); William Mishler, Ph.D. (Duke); Lester M. Salamon, Ph.D. (Harvard); Thomas S. Spragens, Ph.D. (Duke); Richard Trilling, Ph.D. (Wisconsin); Arturo Valenzuela, M.A. (Columbia).

Lecturer

Jean F. O'Barr, Ph.D. (Northwestern).

Courses of Instruction

206. Politics and the Media	231. American Political Theory
207. American Constitutional Interpretation	233. Research Methodology
209. Problems in State Government and Politics	235. The Commonwealth
210. The Politics of Education	236. Statistical Analysis
214. Comparative Administrative Law	237. Seminar in Problems in American Foreign Policy
220. Problems in International Politics	241. Public Administrative Organization and Management
221. International Organization	243. Administrative and Organizational Theory
222. Empirical Theory	244. Administrative Law and Process
223. Political Philosophy from Plato to Machiavelli	245. Ethics and Policy Making
224. Modern Political Theory	246. Administration and Public Policy
225. Comparative Government and Politics— Western Europe	247. Political Participation and Policy Outcomes
226. Theories of International Relations	248. The Politics of the Policy Process
227. International Law	249. Comparative Political Analysis and Political Development
228. Soviet Public International Law	250. Comparative Government and Politics— Southern Asia
229. Recent and Contemporary Political Theory	
230. American National Government	

- 252. Comparative Political Behavior and Socialization
- 253. Comparative Government and Politics: Latin America
- 260. The Tradition of Political Inquiry
- 266. Soviet Foreign Policy
- 271. Political Processes in Traditional and Modern Africa
- 273. Modernization in the American South
- 274. Political Psychology
- 275. The American Party System
- 277. Comparative Party Politics
- 278. Canadian Political Behavior in the North American Context
- 279. The Legislative Process
- 280. Comparative Government and Politics—Sub-Saharan Africa
- 283. Congressional Policy-Making
- 285. The Judicial Process
- 291. Problems of Urban Government
- 293. Federalism
- 303. Seminar in Selected Topics in Statistics
- 304. Seminar in Selected Topics in Empirical Theory
- 306. Seminar in Politics and the Mass Media of Communication
- 310. Seminar in State and Local Government
- 312. Seminar in Constitutional Law
- 313. Education and Public Policy
- 321. Seminar in Political Theory
- 325. Seminar in Comparative Government and Politics
- 328. Seminar in International Law
- 329. Seminar in International Regional Organization
- 330. Seminar in Comparative Government and Politics—Southern Asia
- 331. Seminar in American Political Thought
- 341. Seminar in Public Administration
- 342. Seminar in American National Government and Politics
- 343. Seminar in the Policy Process
- 344. Workshop on Computer Models of Social Systems
- 360. Seminar in Government and Politics in the Soviet Union
- 361. Seminar in Foreign Relations of the Soviet Union
- 376. Seminar in Comparative Political Behavior
- 377. Seminar in Canadian Political Behavior
- 380. Seminar in African Government and Politics
- 381. Seminar in Latin American Government and Politics
- 382. Soviet Law and Society
- 401. Seminar in the Commonwealth
- 402. Interdisciplinary Seminar in the History of the Social Sciences

Psychology

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, developmental, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in basic science: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which describes the program in more detail and gives information on financial assistance, facilities, and current research activity.

Professors

Irving Emanuel Alexander, Ph.D. (Princeton). Chairman; Lloyd Joseph Borstelmann, Ph.D. (California at Berkeley); Jack Williams Brehm, Ph.D. (Minnesota); Robert Charles Carson, Ph.D. (Northwestern); Irving Thomas Diamond, Ph.D. (Chicago); James B. Duke Professor of Psychology; Norman Guttman, Ph.D. (Indiana); Edward Ellsworth Jones, Ph.D. (Harvard); Martin Lakin, Ph.D. (Chicago); Gregory Roger Lockhead, Ph.D. (Johns Hopkins); Harold Schiffman, Ph.D. (Princeton); John Staddon, Ph.D. (Harvard). Director of Graduate Studies; Michael A. Wallach, Ph.D. (Harvard).

Associate Professors

Robert Costanzo, Ph.D. (Florida); Carl John Erickson, Ph.D. (Rutgers); Robert Porter Erickson, Ph.D. (Brown); William C. Hall, Ph.D. (Duke); Cliff Waldron Wing, Jr., Ph.D. (Tulane).

Assistant Professors

David Aderman, Ph.D. (Wisconsin); John D. Coie, Ph.D. (California at Berkeley); Carol Ecker- man, Ph.D. (Columbia); Gregory W. Fischer, Ph.D. (Michigan); William Kalat, Ph.D. (Pennsylvania); Irwin Kremen, Ph.D. (Harvard); Thomas T. Norton, Ph.D. (California at Los Angeles); G. M. Robinson, Ph.D. (Chicago); Susan Roth, Ph.D. (Northwestern); Charles W. White, Ph.D. (Stanford).

Lecturers

John H. Casseday, Ph.D. (Indiana); Edward Clifford, Ph.D. (Minnesota); Judith Conger, Ph.D. (Illinois); Elaine Kobrin Crovitz, Ph.D. (Duke); Herbert Floyd Crovitz, Ph.D. (Duke); Ila Gehman,

Ed.D. (Pennsylvania); W. Doyle Gentry, Ph.D. (Florida State); Marcel Kinsbourne, M.D. (Oxford); Arnold David Krugman, Ph.D. (Kentucky); Walter Dorn Obrist, Ph.D. (Northwestern); Ronald W. Oppenheim, Ph.D. (Washington); Talmadge Lee Peele, M.D. (Duke); William Derek Shows, Ph.D. (Duke); George G. Somjen, M.D. (New Zealand); Larry W. Thompson, Ph.D. (Florida State); Lise Wallach, Ph.D. (Kansas); M. L. Wolbarsht, Ph.D. (Johns Hopkins).

Courses of Instruction

203. Sensation and Perception	293. Methods of Developmental Psychology
204. Comparative Psychology	305. Psychopathology
210. Cognitive Psychology	306. Seminar in Developmental Psychology
213. Adaptive Behavior	309. Seminar in Learning
215. Developmental Psychology	310. Seminar in Perception
216. Biological Psychology	313. Seminar on the Concept of the Reflex
217. Social Psychology	314. Seminar in Instrumental Behavior
218. Research Methods in Social Psychology	316. Seminar in Social Psychology
219. Neural Bases of Behavior	317. Seminar in Social Behavior
220. Physiological Bases of Behavior	318. Seminar in Social Influence
228. Visually Guided Behavior	319-320. Research-Clinical Tutorial
234. Seminar in Personality	321. Seminar in Psychophysiology of Hearing
238. Electroencephalogram and Psychological Function	325. Seminar in Neuroendocrinology and Behavior
239. Behavioral Correlates of Brain Damage in Man	327, 328. Foundations of Clinical Psychology
245. Personality Theory I	329-330. Seminar in Psychology
246. Personality Theory II	333, 334. Seminar: Behavioral Studies of the Brain
271. Seminars in Selected Problems	335-336. Clinical Inquiry I
273-274. Principles of Psychological Measurement	337. Seminar in Sensory Discrimination
276. Comparative Neurology and Psychology	340. Group Processes and Sensitivity Training
282. Introduction to Methods in Psychotherapy	343, 344. Clinical Inquiry II
283, 284. The History of Psychology	347-348. Personality Assessment
291. Seminar in Community Mental Health	350. Practicum in Psychological Research

Public Policy Sciences

The graduate program in Public Policy Sciences is offered through the Institute of Policy Sciences and Public Affairs. The course of study consists of a series of joint degree programs leading to the degrees of Master of Arts in Public Policy Sciences, and a doctoral or professional degree. Such a program is designed to foster in highly trained professionals the perceptual and analytical skills necessary for sound public decision-making. The Institute does not award independent A.M. or Ph.D. degrees.

With the exception of those individuals already possessing doctoral or professional degrees, therefore, all graduate students in the Institute must pursue a concurrent degree in another department or school at Duke, or at a nearby cooperating institution. Joint degree programs exist or are being developed between the Institute and the Schools of Law, Engineering, Medicine, and Business Administration, and with several graduate departments.

Students usually apply for the joint degree program simultaneously with application to their graduate departments or professional schools, or during their first or second year of advanced study. Candidates are expected to complete an equivalent or one full year of work beyond what their doctoral or professional degree would require alone.

The joint degree curriculum involves a minimum of ten courses, to be specified by the Institute. Academic work includes a four course research sequence and a summer internship in such specialized policy areas as law and the administration of justice, communications, health, and education. This policy research sequence, in which the student works closely with faculty in tutorial or small group situations, stresses the development of analytical skills applicable to the broad range of policy arenas.

Further information concerning specific joint degree programs may be obtained from the Director of Graduate Studies.

Professors

Edward Harvey Estes, Jr., M.D. (Emory); Jerry F. Hough, Ph.D. (Harvard).

Associate Professors

Robert D. Behn, Ph.D. (Harvard); Joel Lawrence Fleishman, L.L.M. (Yale), Director; David L. Lange, LL.B. (Illinois); David E. Price, B.D., Ph.D. (Yale).

Assistant Professors

Joseph C. Bell, Ph.D. (Harvard); Philip J. Cook, Ph.D. (California at Berkeley); Gregory W. Fischer, Ph.D. (Michigan); Willis D. Hawley, Ph.D. (California at Berkeley), Director of Graduate Studies; Lester M. Salamon, Ph.D. (Harvard); James Walton Vaupel, Ph.D. (Harvard).

Adjunct Assistant Professor

Richard M. Scheffler, Ph.D. (New York University).

Courses of Instruction

217. The Application of Microeconomics to Public Policymaking	224. Administrative and Organizational Theory
219. The Politics of the Policy Process	247. Political Participation and Policy Outcomes
221. Analytical Methods I: Forecasting Consequences of Policy Alternatives	258. Seminar on Aging .
222. Analytical Methods II: Appraising Consequences of Policy Alternatives	310. Analytical Methods III: Experimentation and Evaluation
223. Ethics and Policy Making	340-390. Public Policy Research Seminars

Religion

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of three fields: (1) Biblical studies; (2) historical studies; and (3) systematic and contemporary studies.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies. This minor requirement may be fulfilled either by work in a cognate department, such as Classical Studies, History, Political Science, or Sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a grounding in religion such as is usually derived from the course content of theoretical subjects of a seminary curriculum. Candidates for admission to the doctoral program are favored, therefore, who hold a B.D. or equivalent degree from an accredited seminary or who have had at least two years of seminary study beyond the A.B. degree. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only on the condition of satisfactory completion of the A.M. degree with the department.

Professors

Frank Baker, B.D., Ph.D. (Nottingham); W. Waldo Beach, B.D., Ph.D. (Yale); David Bradley, Ph.D. (Yale); Robert E. Cushman, B.D., Ph.D., L.H.D. (Yale); William David Davies, B.D., M.A., D.D. (Wales), George Washington Ivey Professor of Advanced Studies and Research in Christian Origins; Stuart C. Henry, B.D., Ph.D. (Duke); Frederick L. Herzog, Th.D. (Princeton); Creighton Lacy, B.D., Ph.D. (Yale); Thomas A. Langford, B.D., Ph.D. (Duke); Roland E. Murphy, S.T.D. (Catholic University); Robert Osborn, B.D., Ph.D. (Drew); William H. Poteat, B.D., Ph.D. (Yale), Chairman; James L. Price, B.D., Ph.D. (Cambridge); D. Moody Smith, Jr., B.D., Ph.D. (Yale); Franklin W. Young, D.B., Ph.D. (Duke), Director of Graduate Studies, Amos Rogan Kearns Professor of New Testament and Pastoral Studies.

Associate Professors

Lloyd Richard Bailey, Ph.D. (Yale); Henry B. Clark, B.D., Ph.D. (Yale); Wesley A. Kort, B.D., Ph.D. (Chicago); Eric M. Meyers, Ph.D. (Harvard); Harry B. Partin, B.D., Ph.D. (Chicago); Jill

Raitt, Ph.D. (Chicago); Charles K. Robinson, B.D., Ph.D. (Duke); Harmon L. Smith, B.D., Ph.D. (Duke); David Curtis Steinmetz, Th.D. (Harvard); Orval Wintermute, B.D., Ph.D. (Johns Hopkins).

Assistant Professors

James H. Charlesworth, B.D., Ph.D. (Duke); Bruce Lawrence, Ph.D. (Yale).

BIBLICAL STUDIES

Courses of Instruction

207. Second Hebrew
208. Second Hebrew
209. Old Testament Theology
223A. Exegesis of the Hebrew Old Testament: Amos and Hosea
223B. Exegesis of the Hebrew Old Testament: Job
223C. Exegesis of the Hebrew Old Testament: Exodus
225. Living Issues in New Testament Theology
226A. Exegesis of the Greek New Testament I (Mark and Matthew)
226B. Exegesis of the Greek New Testament I (Romans)
226D. Exegesis of the Greek New Testament I (I and II Corinthians)
226E. The Gospel and Epistles of John
227A. Exegesis of the Greek New Testament II (Luke-Acts)
227B. Exegesis of the Greek New Testament II (Galatians)
227C. Exegesis of the Greek New Testament II (The Pastoral Epistles)
228. The Theology of the Gospel and Epistles of John
237. History of the Ancient Near East
244. The Archaeology of Palestine in Hellenistic-Roman Times
258. Coptic
302. Studies in the Intertestamental Literature
304. Aramaic
304A. Targumic Aramaic
305. Third Hebrew
306. Language and Literature of the Dead Sea Scrolls
307. Syriac
311. Pharisaic Judaism in the First Century
312. Pauline Theology
314. Judaism and Christianity in the New Testament
319. The Gospel According to St. Matthew in Recent Research
323A. Comparative Semitic I
323B. Comparative Semitic II
340-341. Seminar in the New Testament
345. The Epistle to the Hebrews in Recent Research
350-351. Old Testament Seminar
373-374. Elementary Akkadian
375-376. Elementary Ugaritic
401. Colloquium in Biblical Studies

HISTORICAL STUDIES

217. Islam in India
218. Religion in Japan
236. Luther and the Reformation in Germany
241. Problems in Reformation Theology
246. Problems in Historical Theology
247. Readings in Latin Theological Literature
251. The Counter-Reformation and the Development of Catholic Dogma
260. Seminar: Wesley Studies
280. The History of Religions
282. Myth and Ritual
283. Religions of East Asia
284. The Religion and History of Islam
285. The Vedic Tradition: Its Compilation and Interpretation
287. The Scriptures of Asia
288. Buddhist Thought and Practice
289. World Religions and Social Change
296. Religion on the American Frontier
308. Greek Patristic Texts
313. The Apostolic Fathers
315-316. Seminar: History of Religions
317. Seminar in the Greek Apologists
318. Seminar in the Greek Fathers
334. Church Reformers and Christian Unity
335. The English Church in the Eighteenth Century
336. Christian Mysticism in the Middle Ages
338. Calvin and the Reformation in Switzerland
339. The Radical Reformation
344. Zwingli and the Origins of Reformed Theology
384. Religious Dissent in American Culture
385. Religion in American Literature
391. Historical Types of Christian Ethics I
392. Historical Types of Christian Ethics II
395. Christian Thought in Colonial America
396. Liberal Traditions in American Theology

SYSTEMATIC AND CONTEMPORARY STUDIES

210. Contemporary British Theology
211. Authority in Theology
214. The Christian Doctrine of Salvation
230. The Meaning of Religious Language

231. Seminar in Christianity and Contemporary Thought	322. Nineteenth Century European Theology
232. Religion and Literature: Perspectives and Methods	325. Philosophical Theology I
233. Modern Narrative and Religious Language	326. Philosophical Theology II
245. Ethics in World Religions	328. Twentieth Century European Theology
248. The Theology of Karl Barth	361. Language and Biblical Criticism
249. The Church in Contemporary Theology	377. Contemporary American Dramatic Arts and Evolving Theological Forms
262. Marxist Ideology and Christian Faith	380. Existentialist Thought
281. Phenomenology and Religion	383. Moral Theology in the Twentieth Century
292. Christian Ethics and International Relations	386. Christianity in Dialogue with Other Faiths
293. Sociological Analysis of Religion	388. Ethics and Medicine
294. Institutional Analysis of Religious Bodies	389. Christian Ethics and Contemporary Culture
295. Ethics and Economic Life	390. Current Problems in Christian Ethical Theory
300. Systematic Theology	394. Christianity and the State
303. The New Hermeneutic and the Idea of History	397. Contemporary American Theology
320. Hegel and Schleiermacher	398. Colloquium on the College and University Teaching of Religion

Romance Languages

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for either the A.M. and Ph.D. degree will minor in a second Romance language; however, minor work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours (or equivalent) above the intermediate level in the major language.

Professors

Thomas Howard Cordle, Ph.D. (Yale); Gifford Davis, Ph.D. (Harvard); John Morton Fein, Ph.D. (Harvard); Wallace Fowlie, Ph.D. (Harvard); Robert Niess, Ph.D. (Minnesota); Richard Lionel Predmore, D.M.L. (Middlebury); Marcel Tetel, Ph.D. (Wisconsin). Chairman; Bruce W. Wardropper, Ph.D. (Pennsylvania), William H. Wonnomoker Professor of Romance Languages.

Associate Professors

Miguel Garci-Gomez, Ph.D. (Catholic); Alexander Hull, Ph.D. (Washington); Philip Stewart, Ph.D. (Yale); Patrick R. Vincent, Ph.D. (Johns Hopkins). Director of Graduate Studies.

Assistant Professors

Louis E. Auld, Ph.D. (Bryn Mawr); Ernesto Caserta, Ph.D. (Harvard); Richard L. Landeira, Ph.D. (Indiana).

FRENCH

209. Advanced Composition and Syntax	224. History of the French Language
210. The Structure of French	225. French Prose of the Sixteenth Century
213, 214. French Literature of the Seventeenth Century	226. French Poetry of the Sixteenth Century
217. French Symbolism	228. French Poetry of the Twentieth Century
219. Old French Literature	233. Contemporary French Theater
220. French Pre-Romantic and Romantic Poetry	234. Proust
221, 222. The Nineteenth Century French Novel	241, 242. French Literature of the Eighteenth Century
223. French Literary Criticism	245, 246. French Literature of the Twentieth Century
	311, 312. French Seminar

ITALIAN

283. Italian Novel of the Novecento
284. Dante

288. The Renaissance

SPANISH

251. The Origins of the Spanish Novel
252. Spanish Lyric Poetry Before 1700
253. The Origins of the Spanish Theater
255, 256. Modern Spanish American Literature
257. Old Spanish
258. Old Spanish Literature
259. Spanish Phonetics

260. Origins and Development of Spanish Romanticism
261. Nineteenth Century Novel
262. Galdós
265. Golden Age Literature: Cervantes
266. Golden Age Literature: The Drama
275, 276. Contemporary Spanish Literature
321, 322. Hispanic Seminar

ROMANCE LANGUAGES

218. The Teaching of Romance Languages

Slavic Languages and Literature

The Department of Slavic Languages and Literatures inaugurated in 1971 a graduate program leading to the A.M. degree. Initially, graduate students will be able to major only in Russian language and literature, but there will be limited training in the language and literature of Poland.

Applicants should have sufficient undergraduate preparation in the Russian language to enable them to read Russian classical literature in the original.

Associate Professors

Bronislas de Leval Jezierski, Ph.D. (Harvard), Director of Graduate Studies; Magnus J. Krynski, Ph.D. (Columbia), Chairman; Michael I. Pavlov, Ph.D. (Leningrad).

Courses of Instruction

201, 202. The Novelists of Nineteenth Century Russia
205. The Structure of Polish in Relation to Russian
206. Readings in Contemporary Polish Prose in the Original
207. Soviet Literature and Culture
209. Readings in Contemporary Polish Prose in the Original
212. Pushkin
213. The Slavs: Literature and Culture, 1918-1939
214. The Poles: Literature and Culture, 1940-1970
215, 216. Advanced Composition and Syntax
*224. The Russian Short Story—Eighteenth Century to the Present
225. Tolstoy
*227. Gogol
230. Chekhov and the Russian Prose of the Turn of the Century
232. Dostoevsky
*236. Russian and Polish Romanticism

*Offered on demand.

Sociology

The department offers graduate work leading to Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admission should submit scores on the Graduate Record Examination, especially the Aptitude Test.

Candidates for the Ph.D. degree in sociology are expected to demonstrate in qualifying and preliminary examinations a broad background in the various aspects of sociology—substantive, theoretical, and empirical. The program of each candidate is determined by a committee which reviews his previous work and sets the specific re-

quirements to be met. These requirements will include work in related fields such as anthropology, economics, mathematics, philosophy, political science, or psychology. Emphasis is placed on the completion of the dissertation, directed by a member of the staff, demonstrating competence and independence in the investigation of an original and significant problem.

Further details of this program, the departmental facilities, the staff, and various stipends available, are described in a brochure which may be obtained from the Director of Graduate Studies.

Professors

Kurt W. Back, Ph.D. (MIT); Alan C. Kerckhoff, Ph.D. (Wisconsin), Chairman; George L. Maddox, Jr., Ph.D. (Michigan State); John C. McKinney, Ph.D. (Michigan State); George C. Myers, Ph.D. (Washington); Erdman B. Palmore, Ph.D. (Columbia); Jack H. Preiss, Ph.D. (Michigan State); Donald F. Roy, Ph.D. (Chicago); Joel Smith, Ph.D. (Northwestern); Edward A. Tiryakian, Ph.D. (Harvard).

Associate Professors

Ida Simpson, Ph.D. (North Carolina); John Wilson, D.Phil. (Oxford), Director of Graduate Studies.

Assistant Professors

Lee Brehm, Ph.D. (North Carolina); Charles Hirschman, Ph.D. (Wisconsin); James S. House, Ph.D. (Michigan).

Courses of Instruction

225. Medical Sociology	325. Social Aspects of Mental Illness and Treatment
241. Social Stratification	341. Special Problems of Complex Systems
242. The Sociology of Occupations and Professions	344. Workshop on Computer Models of Social Systems
243. Population Dynamics and Social Change	345, 346. Demographic Techniques I and II
247. Community and Society	351, 352. Seminar in Social Organization
251. The Sociology of Modernization	361. Seminar in Comparative Sociology
253. Social Institutions	373, 374. Social Psychological Issues in Sociology
255. Race and Culture	381. Development of Sociological Theory
259. Religion and Social Change	385, 386. Seminar in Sociological Theory
272. The Socialization Process	390. Seminar in Field Methods of Sociological Research
275. Social Attitudes and Individual Behavior	392. Individual Research in Sociology
278. Social Structure and the Life Cycle	397, 398. Seminar in Special Research Problems
295. Methodology in Sociology	402. Interdisciplinary Seminar in the History of the Social Sciences
297. Statistical Analysis in Sociology	
298, 299. Seminar in Selected Topics	
301. Seminar in Human Fertility	
302. Seminar in Migration	

Zoology

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking A.M. or Ph.D. degrees.

In general, a student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the official detailed *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry,

Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

Professors

Joseph R. Bailey, Ph.D. (Michigan); Cazlyn G. Bookhout, Ph.D. (Duke); John D. Costlow, Jr., (Duke); Donald J. Fluke, Ph.D. (Yale); Chaimon; Nicholas W. Gillham, Ph.D. (Harvard); John R. Gregg, Ph.D. (Princeton); Peter H. Klopfer, Ph.D. (Yale); Daniel A. Livingstone, Ph.D. (Yale); R. Bruce Nicklas, Ph.D. (Columbia); Knut Schmidt-Nielsen, Dr. Phil. (Copenhagen), James B. Duke Professor of Physiology in Zoology; Vance A. Tucker, Ph.D. (California at Los Angeles); Karl M. Wilbur, Ph.D. (Pennsylvania), James B. Duke Professor of Zoology.

Associate Professors

Richard T. Barber, Ph.D. (Stanford); Steven Vogel, Ph.D. (Harvard); Stephen A. Wainwright, Ph.D. (California), Director of Graduate Studies; Calvin L. Ward, Ph.D. (Texas).

Adjunct Associate Professor

Klaus Schmidt-Koenig, Ph.D. (Freiburg).

Assistant Professors

Jan Bergeron, V.M.D. (Pennsylvania); Richard B. Forward, Ph.D. (California at Santa Barbara); John G. Lundberg, Ph.D. (Michigan); David R. McClay, Ph.D. (North Carolina); John P. Sutherland, Ph.D. (California at Berkeley); H. Wilbur, Ph.D. (Michigan).

Courses of Instruction

201. Animal Behavior	254. Fluid Flow and Living Systems
202. Introduction to Comparative Behavior	258. Laboratory and Research Methods
203. Marine Ecology	260. Advanced Cell Biology
204. Population and Community Ecology	262. Cytological Materials and Methods
205. Elements of Theoretical Biology	266. Topics in Cell Structure and Function
214. Biological Oceanography	274. Marine Invertebrate Zoology
216. Limnology	275. Invertebrate Zoology
218. Paleobiology	277. Endocrinology of Marine Animals
224. Vertebrate Zoology	278. Invertebrate Embryology
229. Morphogenetic Systems	280. Principles of Genetics
236. Human Genetics	286. Evolution
238. Systematic Zoology	286L. Evolution
239. Biogeography	288. The Cell in Development and Heredity
245. Radiation Biology	295, 296. Seminar
246. Physical Biology	351, 352. Departmental Seminar
248. Introductory Biochemistry	353, 354. Research
250. Physiological Ecology of Marine Animals	355, 356. Seminar
252. Comparative Physiology	360, 361. Tutorials

MAP OF DUKE UNIVERSITY

East Campus

A	Baldwin Auditorium	O	Pegram House
B	Bassett House	P	Duke Press
C	Brown House	Q	Infirmary
D	Union Building	R	Ark
E	Faculty Apartments	S	Crowell Building
F	Art Museum, Geology	T	Epworth Inn
G	Aycock House	U	Gilbert-Addoms House
H	East Duke Building	V	Southgate Hall
I	West Duke Building	X	Woman's College
J	Jarvis House	Y	Gymnasium
K	Carr Building	Z	Asbury Building
L	Giles House	AA	Bivins Building
M	Woman's College Library	BB	Branson Building
N	Alspaugh House		

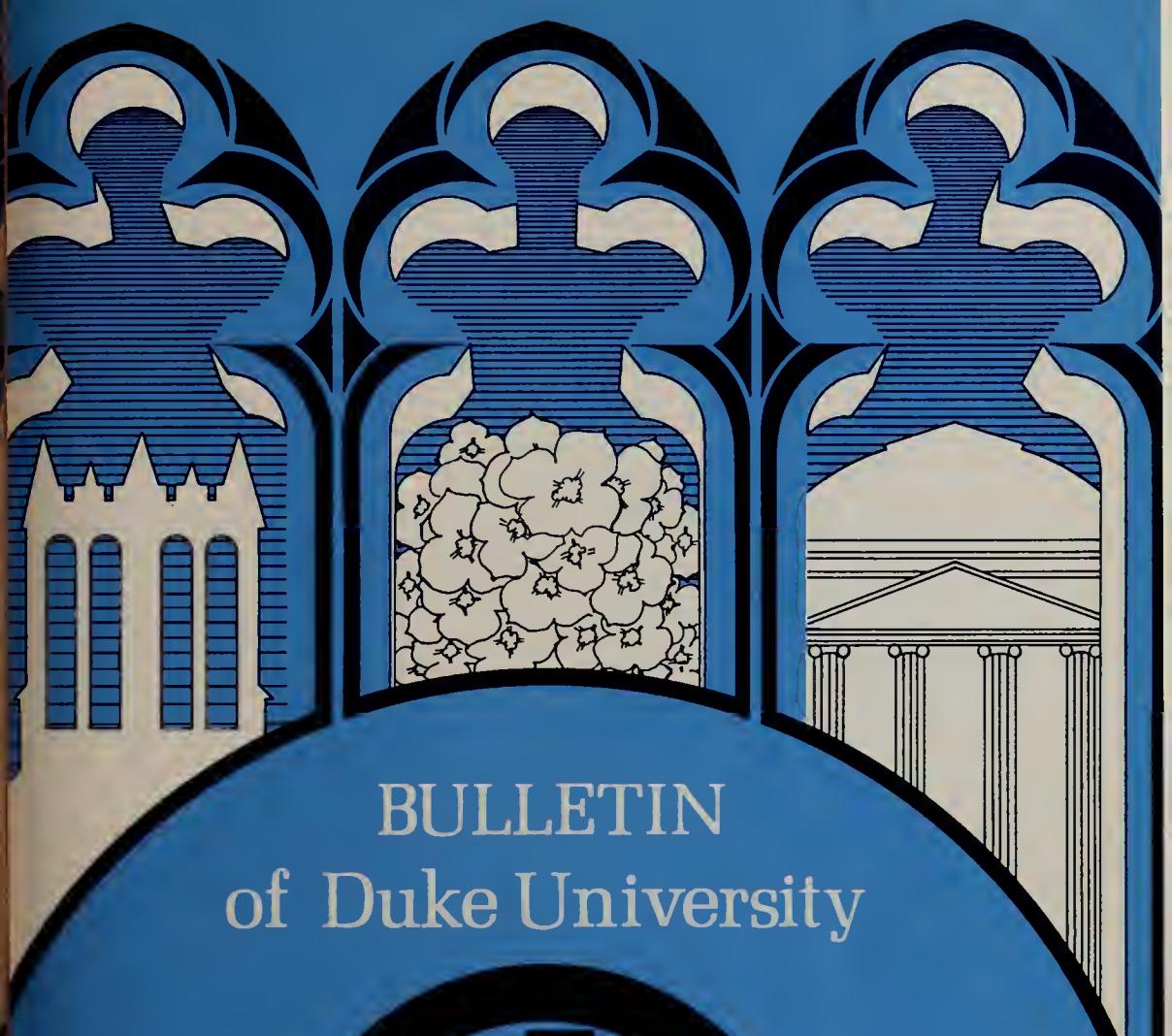


West Campus

A	Duke Chapel	H	Hospital Main Entrance	O	Craven Quadrangle
B	Divinity School	I	Gerontology, D. & T.	P	Wannamaker Hall
C	Gray Building	J	Clinical Research	Q	Crowell Quadrangle
D	Perkins Library	K	Duke Hospital	R	Clock Tower Court
E	Language Center	L	Sociology, Psychology	S	Kilgo Quadrangle
F	Old Chemistry Building	M	Social Sciences	T	Union Building
G	Davison Building	N	Allen Building	U	Flowers Building
	School of Medicine		Few Quadrangle		Page Auditorium
					V Card Gymnasium
					W Indoor Stadium
					X School of Law
					Y Gross Chemical Laboratory
					Z Biological Sciences
					AA Plant Environment
					BB Physics Building
					CC Nuclear Laboratory
					DD School of Engineering
					EE Army Research
					FF Medical Center Research Buildings
					GG Nanaline H. Duke Medical Sciences Building
					HH Warehouse, Shop
					II Bell Building
					JJ Hanes House
					School of Nursing
					KK Hanes House Annex
					LL Pickens Rehabilitation Center
					MM Graduate Center
					NN Alumni House
					DD Commonwealth Studies Center
					PP Personnel Office
					QQ International House
					RR Personnel Office
					SS Education Improvement Program
					TT A Better Chance Program
					UU International Studies Center
					VV Campus Stores Office
					WW Office of Institutional Advancement
					XX Information Services
					YY Visitors Bureau
					XX Admissions Office
					YY Edens Quadrangle
					ZZ Wade Stadium



BULLETIN OF DUKE UNIVERSITY
The Graduate School
Vol. 46 No. 6 February 1974

A decorative border at the top of the page features a stained-glass window design. It consists of three vertical panels. The left panel shows a building with a gabled roof and several arched windows. The middle panel contains a large cluster of white flowers. The right panel depicts a classical building with a pediment and columns. The entire border is set against a dark blue background.

BULLETIN of Duke University

1974

1975



GRADUATE SCHOOL

**Bulletin of
Duke University
Graduate School**

1974-1975

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Contents

Calendar of the Graduate School	iv
University Administration	vii
Instructional Staff	viii
1 Program Information	3
The Master's Degrees	3
The Doctor's Degrees	9
2 Special and Cooperative Programs	15
3 Resources for Study	27
The Libraries	27
Science Laboratories	29
4 Student Life	37
Living Accommodations	37
Services Available	38
Student Affairs	41
Research and Publications	42
Visiting Scholars	42
5 Admission	45
6 Financial Information	49
Tuition and Fees	49
Expenses	51
Fellowships and Scholarships	51
Assistantships	54
Loans	55
7 Registration and Regulations	57
Registration	57
Academic Regulations	58
Standards of Conduct	63
8 Graduate Study in the Summer	67
9 Courses of Instruction	69
Degrees Conferred May 1972	199
Degrees Conferred September 1972	203
Index	207

Calendar of the Graduate School 1974-1975

Summer Session 1974

April

2-3 Tuesday-Wednesday—Registration for fall and summer, 1974.
15 Monday—Final date for completing application for admission to the summer session, Term I.

May

10 Friday—Completion of registration for Term I.
14 Tuesday—First class day except for undergraduate courses in chemistry, geology, and physics.
15 Wednesday—Final date for completing application for admission to the summer session, Term II.
18 Saturday—Classes will be held.
20 Monday—First class day for chemistry, geology, and physics.

June

10 Monday—Final date to register for English examination. Registration is taken in the Graduate School Office. This examination is open to students eligible to use English as a foreign language.
14-15 Friday-Saturday—Final examinations for Term I.
14 Friday—Completion of registration for Term II.
14 Friday—Final date for completing application for admission to the summer session, Term III.
14 Friday—Examination for students electing English for a foreign language requirement; room and hours to be announced.
17 Monday—First class day for all courses in Term II.

July

16-17 Tuesday-Wednesday—Final examinations for Term II.
17 Wednesday—Completion of registration for Term III.
18 Thursday—First class day for Term III.

August

1 Thursday—Final date for filing with the Graduate School Office the Statement of Intention to complete requirements for an advanced degree during the summer session. If a thesis is to be presented, the title is to be filed at the same time as the Statement of Intention.
15 Thursday, 12:00 p.m.—Last day for submitting theses for advanced degrees.
16-17 Friday-Saturday—Final examinations for Term III.
17 Saturday—Final date for completion of requirements for Graduate School degrees to be awarded September 1.

Academic Year 1974-1975

	26-28	Monday-Wednesday—Registration and matriculation of all new and nonregistered returning students in the Graduate School.
	26-28	Monday-Wednesday—Consultation with directors of graduate study concerning course program.
	27	Tuesday, 9:00 a.m.—English examination for foreign students; 111 Biological Sciences Building. (See chapter on Admission for section on Additional Procedures for Foreign Students.)
September		
	3	Tuesday, 9:00 a.m.—Fall semester classes begin.
	4	Wednesday, 4:00-6:00 p.m.—Drop/Add begins. Indoor Stadium.
	5-6	Thursday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
	9-13	Monday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
	13	Friday—Final date for changes in registration which involve adding courses, provided no reduction in fees is entailed.
	27	Friday—Final date for dropping course-seminar registration and adding equivalent units of research.
October		
	4	Friday—Final date for change in registration resulting from passing a preliminary examination.
	23	Wednesday—Final date to register for English examination. Registration is taken in the Graduate School Office. This examination is open only to students eligible to use English as a foreign language requirement.
	28-29	Monday-Tuesday—Registration for spring, 1975.
	30	Wednesday—Examination for students electing English for a foreign language requirement; room and hours to be announced.
November		
	26	Tuesday, 6:00 p.m.—Thanksgiving recess begins.
December		
	2	Monday, 9:00 a.m.—Classes are resumed.
	3	Tuesday—Final date for applying for admission to the spring semester.
	5	Thursday—Fall semester classes end.
	6-12	Friday-Thursday—Reading period.
	8	Sunday—Founders' Day.
	13	Friday—Final examinations begin.
	20	Friday—Final examinations end.
January		
	8	Wednesday, 2:00 p.m.—English examination for foreign students; 309 Flowers Building. (See chapter on Admission for section on Additional Procedures for Foreign Students.)
	10	Friday—Registration for new and nonregistered returning students.
	13	Monday, 9:00 a.m.—Spring semester classes begin.
	14	Tuesday, 4:00-6:00 p.m.—Drop/Add begins. Indoor Stadium.
	15-17	Wednesday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
	20-24	Monday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
	24	Friday—Final date for changes in registration which involve adding courses, provided that no reduction in fees is entailed.
February		
	3	Monday—Final date for filing with the Graduate School Office the Statement of Intention of receiving an advanced degree in May. Titles of theses and dissertations are to be filed concurrently with the Statement of Intention.
	7	Friday—Final date for dropping course-seminar registration and adding equivalent units of research.
	14	Friday—Final date for change in registration resulting from passing preliminary examination.

March		
	7	Friday—Final date to register for English examination. Registration is taken in the Graduate School Office. This examination is open only to students eligible to use English as a foreign language requirement.
	7	Friday, 6:00 p.m.—Spring recess begins.
	17	Monday, 9:00 a.m.—Classes are resumed.
	21	Friday—Examination for students electing English for a foreign language requirement; room and hours to be announced.
	3/31-4/1	Monday-Tuesday—Registration for fall semester, 1975 and summer, 1975.
April		
	1	Tuesday—Last day for submitting dissertations Ph.D. and Ed.D. degrees.
	15	Tuesday—Last day for submitting theses for A.M., M.S., M.Ed., and M.A.T. degrees.
	15	Tuesday—Last day for applying for admission to the summer session, Term I, 1975.
	21	Monday—Spring semester classes end.
	22-28	Tuesday-Monday—Reading period.
	29	Tuesday—Final examinations begin.
May		
	6	Tuesday—Final examinations end.
	10	Saturday—Commencement begins.
	11	Sunday—Baccalaureate Services and Commencement Exercises.
	15	Thursday—Final date for completing application for admission to the summer session, Term II, 1975.



University Administration

General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., President
John O. Blackburn, Ph.D., Chancellor
Frederick N. Cleaveland, Ph.D., Provost
Charles B. Huestis, Vice President for Business and Finance
William G. Anlyan, M.D., Vice President for Health Affairs
Juanita M. Kreps, Ph.D., Vice President
Stephen Cannada Harward, A.B., C.P.A., Treasurer and Assistant Secretary
J. Peyton Fuller, A.B., Controller
J. David Rass, J.D., Director of Development and Director of Campaign Planning
Harold W. Lewis, Ph.D., Vice Provost and Dean of the Faculty
John C. McKinney, Ph.D., Vice Provost and Dean of the Graduate School
Anne Flowers, Ed.D., Acting Vice Provost and Acting Dean of Trinity College of Arts and Sciences
Frederick C. Jaerg, M.B.A., Assistant Provost for Academic Administration
Joel L. Fleishman, LL.M., Vice Chancellor for Public Policy Education and Research; Director of Institute for Policy Sciences and Public Affairs
Benjamin Edward Powell, Ph.D., Librarian
William E. King, Ph.D., University Archivist
Clark R. Cahow, Ph.D., University Registrar and Acting Director of Admissions
Olan Lee Petty, Ph.D., Director of the Summer Session
Victor A. Bubas, B.S., Assistant to the President
Rufus H. Powell, LL.B., Secretary of the University
A. Kenneth Pye, LL.M., University Counsel

Graduate School Administration

John C. McKinney, Ph.D., Dean of the Graduate School
Dale B. J. Randall, Ph.D., Associate Dean
Charles M. Harman, Ph.D., Associate Dean
Leesa H. Campbell, M.A., Assistant to the Dean
Frances C. Thomas, A.B., Administrative Assistant

Executive Committee of the Graduate Faculty

Dean John C. McKinney

M. Margaret Ball	Aubrey W. Naylor (Alt.)*	Stephen A. Wainwright (Alt.)
William H. Cartwright*	Loren Nolte*	Seth L. Warner (Alt.)*
Jack B. Chaddock (Alt.)	Holger O. Nygard*	E. Roy Weintraub (Alt.)
Donald B. Chesnut	Harry B. Partin (Alt.)*	William H. Willis
Walter R. Guild*	Marcel Tetel (Alt.)	Charles R. Young*
Thomas J. McManus		

*Term expires September, 1974.

Instructional Staff

Members of the Graduate School Faculty

(As of October 1, 1973.)

The date denotes the first year of service at Duke University.

¹Frances Dorothy Acomb (1945), Ph.D., Associate Professor of History
Anne H. Adams (1971), Ed.D., Professor of Education
Dolph O. Adams (1972), M.D., Ph.D., Assistant Professor of Pathology
Mark Adelman (1971), Ph.D., Assistant Professor of Anatomy
David Aderman (1970), Ph.D., Assistant Professor of Psychology
John Richard Alden (1955), Ph.D., James B. Duke Professor of History
Carole A. Aldrich (1970), Ph.D., Assistant Professor of Business Administration
Irving Alexander (1963), Ph.D., Professor of Psychology
A. Tilo Alt (1961-65; 1967), Ph.D., Assistant Professor of German
D. Bernard Amos (1962), M.D., James B. Duke Professor of Immunology
Carl Anderson (1955), Ph.D., Professor of English
Lewis Edward Anderson (1936), Ph.D., Professor of Botany
Nels C. Anderson (1966), Ph.D., Assistant Professor of Physiology
Roger Fabian Anderson (1950), Ph.D., Professor of Forest Entomology
Janis Antonovics (1970), Ph.D., Associate Professor of Botany
Stanley Hersh Appel (1964-65; 1967), M.D., Associate Professor of Biochemistry
Mahadeo L. Apté (1965), Ph.D., Associate Professor of Anthropology
Richard E. Aquila (1968), Ph.D., Assistant Professor of Philosophy
John Leslie Artley (1955), D.Eng., Professor of Electrical Engineering
Louis E. Auld (1970), Ph.D., Assistant Professor of Romance Languages
²Kurt W. Back (1959), Ph.D., Professor of Sociology
Rodger W. Baier (1972), Ph.D., Assistant Professor of Chemistry
Joseph Randle Bailey (1946), Ph.D., Professor of Zoology
Lloyd Richard Bailey (1971), Ph.D., Associate Professor of Religion
Frank Baker (1960), Ph.D., Professor of Religion
Kenneth Baker (1973), Ph.D., Professor of Business Administration
Steven W. Baldwin (1970), Ph.D., Assistant Professor of Chemistry
³Helmy Hamdollah Baligh (1967), Ph.D., Professor of Business Administration
M. Margaret Ball (1963), Ph.D., Professor of Political Science
⁴Robert H. Ballantyne (1962), Ed.D., Associate Professor of Education
James David Barber (1972), Ph.D., Professor of Political Science
Richard T. Barber (1970), Ph.D., Associate Professor of Zoology and Associate Professor of Botany
Robert Lloyd Barnes (1965), Ph.D., Professor of Forest Biochemistry
Roger Barr (1969), Ph.D., Associate Professor of Biomedical Engineering
Joseph Battle (1970), Ph.D., Associate Professor of Business Administration

¹Sabbatical leave, fall semester, 1973.

²Sabbatical leave, academic year, 1973-74.

³Sabbatical leave, academic year, 1973-74.

⁴Sabbatical leave, academic year, 1973-74.

⁵William Waldo Beach (1946), Ph.D., Professor of Christian Ethics
Robert D. Behn (1973), Ph.D., Associate Professor of Public Policy Sciences
Joseph C. Bell (1972), LL.B., Assistant Professor of Public Policy Sciences
Robert Bell (1972), Ph.D., Assistant Professor of Biochemistry
Theodore Benditt (1970), Ph.D., Assistant Professor of Philosophy
Peter B. Bennett (1972), Ph.D., Professor of Biomedical Engineering
Jan Bergeron (1969), V.M.D., Assistant Professor of Anatomy and Assistant Professor of Zoology
Charles W. Bergquist (1972), Ph.D., Assistant Professor of History
Frederick Bernheim (1930), Ph.D., James B. Duke Professor of Pharmacology
L. C. Biedenharn, Jr. (1961), Ph.D., Professor of Physics
Alan Biermann (1974), Ph.D., Assistant Professor of Computer Science
Darell D. Bigner (1972), M.D., Ph.D., Assistant Professor of Pathology
William Dwight Billings (1952), Ph.D., James B. Duke Professor of Botany
Edward George Bilpuch (1962), Ph.D., Professor of Physics
J. A. Bittikofer (1970), Ph.D., Associate in Biochemistry
David E. Black (1969), Ph.D., Assistant Professor of Economics
Charles Blake (1972), Ph.D., Assistant Professor of Anatomy
John O. Blackburn (1962), Ph.D., Professor of Economics
William F. Blankley (1972), Ph.D., Assistant Professor of Botany
J. J. Blum (1962), Ph.D., Professor of Physiology
Dani P. Bolognesi (1971), Ph.D., Assistant Professor of Virology
Joseph Bonaventura (1972), Ph.D., Associate Professor of Biochemistry
Cazlyn Green Bookhout (1935), Ph.D., Professor of Zoology
Frank Borchardt (1971), Ph.D., Associate Professor of German
⁶Lloyd J. Borstelmann (1953), Ph.D., Professor of Psychology
Edward H. Bossen (1972), M.D., Assistant Professor of Pathology
John E. Boynton (1968), Ph.D., Associate Professor of Botany
William D. Bradford (1966), M.D., Associate Professor of Pathology
David G. Bradley (1949), Ph.D., Professor of Religion
Charles Kilgo Bradsher (1939), Ph.D., James B. Duke Professor of Chemistry
Ralph Braibanti (1953), Ph.D., James B. Duke Professor of Political Science
Eleanor F. Branch (1972), Ph.D., Associate Professor of Physical Therapy
⁷Jack Brehm (1958), Ph.D., Professor of Psychology
Mary Lee Brehm (1965), Ph.D., Assistant Professor of Sociology
Gert Brieger (1970), M.D., Ph.D., Associate Professor of History
Martin Bronfenbrenner (1971), Ph.D., William R. Kenan, Jr. Professor of Economics
⁸Earl Ivan Brown, II (1960), Ph.D., J. A. Jones Professor of Civil Engineering
⁹Frances Campbell Brown (1931), Ph.D., Professor of Chemistry
C. Edward Buckley, III (1963), M.D., Associate Professor of Immunology
Rebecca Buckley (1968), M.D., Associate Professor of Immunology
Louis J. Budd (1952), Ph.D., Professor of English
Donald S. Burdick (1962), Ph.D., Associate Professor of Mathematics
Peter H. Burian (1968), Ph.D., Assistant Professor of Classics
R. O. Burns (1964), Ph.D., Professor of Microbiology
Richard M. Burton (1970), D.B.A., Associate Professor of Business Administration
¹⁰Ronald Richard Butters (1967), Ph.D., Assistant Professor of English
Gale H. Buzzard (1957), Ph.D., Assistant Professor of Mechanical Engineering
Edwin H. Cady (1973), Ph.D., Professor of English
Philip Calkins (1973), Ph.D., Assistant Professor of History
¹¹Peter F. Carbone (1966), Ed.D., Associate Professor of Education
Leonard Carlitz (1932), Ph.D., James B. Duke Professor of Mathematics
Robert C. Carson (1960), Ph.D., Professor of Psychology
Reginald D. Carter (1970), Ph.D., Assistant Professor of Physiology
Matthew Cartmill (1969), Ph.D., Assistant Professor of Anatomy and Assistant Professor of Anthropology
William H. Cartwright (1951), Ph.D., Professor of Education
Ernesto Caserta (1970), Ph.D., Assistant Professor of Romance Languages
John H. Casseday (1970), Ph.D., Lecturer in Psychology
Ronald W. Cassan (1971), Ph.D., Assistant Professor of Anthropology
John Cell (1962), Ph.D., Associate Professor of History
Jack B. Chaddock (1966), Sc.D., Professor of Mechanical Engineering

⁵Sabbatical leave, academic year, 1973-74.

⁶Sabbatical leave, fall semester, 1973.

⁷Sabbatical leave, academic year, 1973-74.

⁸Sabbatical leave, spring semester, 1974.

⁹Retired, August 31, 1973.

¹⁰Sabbatical leave, academic year, 1973-74.

¹¹Sabbatical leave, spring semester, 1974.

William Chafe (1971), Ph.D., Assistant Professor of History
 Roger C. Chapman (1969), M.S., Assistant Professor of Biometry
 James H. Charlesworth (1969), Ph.D., Assistant Professor of Religion
 Donald B. Chesnut (1965), Ph.D., Professor of Chemistry
 Norman L. Christensen (1973), Ph.D., Assistant Professor of Botany
 Edgar W. Clark (1970), Ph.D., Adjunct Associate Professor of Forest Entomology

¹²Henry B. Clark (1966), Ph.D., Associate Professor of Religion
 Howard G. Clark (1968), Ph.D., Associate Professor of Biomedical Engineering and Professor of Mechanical Engineering
 Frederic N. Cleaveland (1971), Ph.D., Professor of Political Science
 Edward Clifford (1965), Ph.D., Lecturer in Psychology
 Gerald Wayne Clough (1969), Ph.D., Associate Professor of Civil Engineering
 John Clubbe (1966), Ph.D., Associate Professor of English
 Franklin H. Cocks (1972), Ph.D., Associate Professor of Mechanical Engineering
 John D. Coie (1968), Ph.D., Assistant Professor of Psychology
 Robert Taylor Cole (1935), Ph.D., James B. Duke Research Professor of Political Science
 Joel Colton (1947), Ph.D., Professor of History

¹³Robert Merle Colver (1953), Ed.D., Associate Professor of Education
 Norman Francis Conant (1935), Ph.D., James B. Duke Professor of Microbiology
 Judith Conger (1971), Ph.D., Lecturer in Psychology
 Frank J. Convery (1972), Ph.D., Assistant Professor of Forest Economics
 Philip J. Cook (1973), Ph.D., Assistant Professor of Public Policy Sciences
 Samuel DuBois Cook (1966), Ph.D., LL.D., Professor of Political Science
 Thomas Howard Cordle (1950), Ph.D., Professor of Romance Languages
 Philip Robert Costanzo (1968), Ph.D., Associate Professor of Psychology
 John Costlow (1959), Ph.D., Professor of Zoology
 Sheila J. Counce (1968), Ph.D., Associate Professor of Anatomy
 Dario Covi (1970), Ph.D., Professor of Art
 Elaine Crovitz (1965), Ph.D., Lecturer in Psychology
 Herbert F. Crovitz (1963), Ph.D., Lecturer in Psychology
 Alvin L. Crumbliss (1970), Ph.D., Assistant Professor of Chemistry
 Chicita F. Culberson (1961), Ph.D., Lecturer in Botany
 William L. Culberson (1955), Ph.D., Professor of Botany
 Ronald Y. Cusson (1970), Ph.D., Associate Professor of Physics
 Robert Earle Cushman (1945), Ph.D., Professor of Systematic Theology
 Jarir Dajani (1971), Ph.D., Assistant Professor of Civil Engineering
 William W. Damon (1970), Ph.D., Assistant Professor of Business Administration
 Charles Daniels (1970), M.D., Ph.D., Assistant Professor of Pathology
 David G. Davies (1961), Ph.D., Professor of Economics

¹⁴William D. Davies (1966), D.D., George Washington Ivey Professor of Advanced Studies and Research in Christian Origins
 Calvin D. Davis (1962), Ph.D., Associate Professor of History
 Gifford Davis (1930), Ph.D., Professor of Romance Languages
 Lucy Davis (1969), Ed.D., Associate Professor of Education
 Jeffrey R. Dawson (1969), Ph.D., Associate in Immunology
 Eugene Davis Day (1962), Ph.D., Professor of Immunology
 David C. Dellinger (1968), Ph.D., Associate Professor of Business Administration
 Frank C. DeLucia (1969), Ph.D., Assistant Professor of Physics
 Neil de Marchi (1971), Ph.D., Assistant Professor of Economics
 A. Leigh DeNeef (1969), Ph.D., Assistant Professor of English
 Frank Traver de Vyver (1935), Ph.D., Professor of Economics
 Irving Diamond (1958), Ph.D., James B. Duke Professor of Psychology
 Joseph Di Bona (1967), Ph.D., Associate Professor of Education
 Arif Dirlik (1971), Ph.D., Assistant Professor of History
 Frank C. Dorsey (1971), Ph.D., Assistant Professor of Pathology
 W. H. Dray (1973), Ph.D., Professor of Philosophy
 Francis George Dressel (1929), Ph.D., Professor of Mathematics
 Robert J. Drye, Jr. (1973), Ph.D., Adjunct Assistant Professor of Civil Engineering
 Bernard I. Duffey (1963), Ph.D., Professor of English
 Kenneth Lindsay Duke (1940), Ph.D., Associate Professor of Anatomy

¹⁵Robert F. Durden (1952), Ph.D., Professor of History
 Jiri Dvorak (1967), C.Sc., Ph.D., Associate Professor of Civil Engineering
 Carol Eckerman (1973), Ph.D., Assistant Professor of Psychology

¹²Sabbatical leave, academic year, 1973-74.

¹³Sabbatical leave, spring semester, 1974.

¹⁴Sabbatical leave, fall semester, 1973; leave of absence, spring semester, 1974.

¹⁵Sabbatical leave, academic year, 1973-74.

Jane G. Elchlepp (1960), M.D., Ph.D., Associate Professor of Pathology
 Albert Eldridge (1970), Ph.D., Assistant Professor of Political Science
 Howard L. Elford (1969), Ph.D., Assistant Professor of Pharmacology
 Ernest Elsevier (1950), M.S., Associate Professor of Mechanical Engineering

¹⁶Carl Erickson (1966), Ph.D., Associate Professor of Psychology
 Harold Erickson (1970), Ph.D., Assistant Professor of Anatomy
 Robert P. Erickson (1961), Ph.D., Associate Professor of Psychology
 E. Harvey Estes (1953), M.D., Professor of Public Policy Sciences
 Evan A. Evans (1973), Ph.D., Assistant Professor of Biomedical Engineering
 Lawrence Evans (1963), Ph.D., Associate Professor of Physics
 John Wendell Everett (1932), Ph.D., Professor of Anatomy
 Henry A. Fairbank (1962), Ph.D., Professor of Physics
 John Morton Fein (1950), Ph.D., Professor of Romance Languages
 Robert E. Fellows, Jr. (1966), M.D., Ph.D., Associate Professor of Physiology
 Arthur Bowles Ferguson (1939), Ph.D., Professor of History
 Oliver Ferguson (1957), Ph.D., Professor of English
 Bernard F. Fetter (1951), M.D., Professor of Pathology
 Gregory Warren Fischer (1973), Ph.D., Assistant Professor of Psychology and Assistant Professor of Public Policy Sciences
 Peter G. Fish (1969), Ph.D., Associate Professor of Political Science
 Joel Fleishman (1971), LL.M., Associate Professor of Public Policy Sciences
 Anne Flowers (1972), Ed.D., Associate Professor of Education

¹⁷Donald J. Fluke (1958), Ph.D., Professor of Zoology
 Lloyd R. Fortney (1964), Ph.D., Associate Professor of Physics
 Richard B. Forward (1971), Ph.D., Assistant Professor of Zoology
 Wallace Fowlie (1964), Ph.D., James B. Duke Professor of Romance Languages
 Richard G. Fox (1968), Ph.D., Professor of Anthropology
 Ernestine Friedl (1973), Ph.D., Professor of Anthropology
 Irwin Fridovich (1958), Ph.D., Professor of Biochemistry
 William J. Furbish (1954), M.S., Associate Professor of Geology

¹⁸Thomas M. Gallie, Jr. (1954-55; 1956), Ph.D., Professor of Computer Science
 Miguel Garci-Gomez (1973), Ph.D., Associate Professor of Romance Languages
 Devendra P. Garg (1972), Ph.D., Professor of Mechanical Engineering
 Raymond Gavins (1970), Ph.D., Assistant Professor of History
 Ila Gehman (1959), Ed.D., Lecturer in Psychology
 W. Scott Gehman, Jr. (1954), Ph.D., Professor of Psychology in Education
 W. Doyle Gentry (1969), Ph.D., Lecturer in Psychology
 Rhett Truesdale George, Jr. (1957), Ph.D., Assistant Professor of Electrical Engineering
 Gerald E. Gerber (1962), Ph.D., Associate Professor of English
 Susan Gerhart (1973), Ph.D., Assistant Professor of Computer Science
 Robert G. Ghirardelli (1972), Ph.D., Adjunct Associate Professor of Chemistry
 Nicholas W. Gillham (1968), Ph.D., Professor of Zoology
 Sherwood Githens (1962), Ph.D., Professor of Education

¹⁹Craufurd Goodwin (1962), Ph.D., Professor of Economics
 Lawrence C. Goodwyn (1971), Ph.D., Adjunct Assistant Professor of History
 Walter Gordy (1946), Ph.D., LL.D., D.H.C., James B. Duke Professor of Physics
 Alfred T. Goshaw (1973), Ph.D., Assistant Professor of Physics
 Henry Grabowski (1972), Ph.D., Associate Professor of Economics
 Daniel A. Graham (1969), Ph.D., Assistant Professor of Economics
 Doyle G. Graham (1973), Ph.D., Assistant Professor of Pathology
 Ronald C. Greene (1958), Ph.D., Associate Professor of Biochemistry
 Joseph C. Greenfield (1962), M.D., Assistant Professor of Physiology and Pharmacology

²⁰John R. Gregg (1957), Ph.D., Professor of Zoology
 Eugene Grueling (1948), Ph.D., Professor of Physics
 Samson Gross (1960), Ph.D., Professor of Genetics and Biochemistry
 Kazimierz Grzybowski (1967), S.J.D., Professor of Political Science
 Walter R. Guild (1960), Ph.D., Professor of Biophysics
 Robert Burns Gunn (1971), M.D., Professor of Physiology
 John Gutknecht (1969), Ph.D., Assistant Professor of Physiology and Pharmacology
 William F. Gutknecht (1971), Ph.D., Assistant Professor of Chemistry
 Norman Guttmann (1951), Ph.D., Professor of Psychology
 Robert L. Habig (1969), Ph.D., Assistant Professor of Biochemistry
 Donald B. Hackel (1960), M.D., Professor of Pathology

¹⁶Sabbatical leave, academic year, 1973-74.

¹⁷Sabbatical leave, academic year, 1973-74.

¹⁸Sabbatical leave, academic year, 1973-74.

¹⁹Leave of absence, half-time, academic year, 1973-74.

²⁰Sabbatical leave, fall semester, 1973.

Herbert Hacker, Jr. (1965), Ph.D., Associate Professor of Electrical Engineering
 Dwight H. Hall (1968), Ph.D., Assistant Professor of Biochemistry
 Hugh Marshall Hall, Jr. (1952), Ph.D., Professor of Political Science
 Louise Hall (1931), Ph.D., Professor of Architecture
 William C. Hall (1970), Ph.D., Assistant Professor of Anatomy and Assistant Professor of Psychology
 John Hamilton Hallowell (1942), Ph.D., Professor of Political Science
 William E. Hammond (1963), Ph.D., Associate Professor of Biomedical Engineering
 Moo-Yaung Han (1967), Ph.D., Associate Professor of Physics
²¹Philip Handler (1939), Ph.D., James B. Duke Professor of Biochemistry and Nutrition
²²Frank A. Hanna (1948), Ph.D., Professor of Economics
 Charles Morgan Harran (1961), Ph.D., Professor of Mechanical Engineering
 Ellwood Scott Harrar (1936), Ph.D., James B. Duke Professor of Wood Science
 Philip D. Harriman (1968), Ph.D., Assistant Professor of Biochemistry
 Jerome S. Harris (1936), M.D., Associate Professor of Biochemistry
²³Robert B. Hartford (1968), Ph.D., Assistant Professor of Sociology
 Gerald Hartwig (1970), Ph.D., Associate Professor of History
 Thomas M. Havrilesky (1969), Ph.D., Associate Professor of Economics
 Hal Hawkins (1973), Ph.D., Assistant Professor of Pathology
 Willis F. Hawley (1972), Ph.D., Assistant Professor of Political Science and Public Policy Sciences
²⁴William S. Heckscher (1966), Ph.D., Benjamin N. Duke Professor of Art
²⁵Henry Hellmers (1965), Ph.D., Professor of Botany
 Robert William Henkens (1968), Ph.D., Associate Professor of Chemistry
 Stuart C. Henry (1959), Ph.D., Professor of American Christianity
 Charles Henson (1967), Ph.D., Assistant Professor of Mathematics
 Duncan Heron (1950), Ph.D., Professor of Gealogy
 David Guy Herr (1967), Ph.D., Assistant Professor of Mathematics
 Frederick Herzog (1960), Th.D., Professor of Systematic Theology
 R. L. Hill (1961), Ph.D., Professor of Biochemistry
 Brian A. Hills (1968), Ph.D., Adjunct Associate Professor of Biomedical Engineering
 Frederick R. Hine (1958), M.D., Associate Professor of Psychology
²⁶Charles Hirschman (1972), Ph.D., Assistant Professor of Sociology
 George H. Hitchings (1971), Ph.D., Adjunct Professor of Pharmacology
 Marcus Edwin Hobbs (1935), Ph.D., Professor of Chemistry
²⁷Richard Earl Hodel (1965), Ph.D., Associate Professor of Mathematics
 Charles S. Hodges, Jr. (1970), Ph.D., Adjunct Associate Professor of Forest Pathology
 Irving B. Holley, Jr. (1947), Ph.D., Professor of History
 Frederic B. M. Hallyday (1956), Ph.D., Professor of History
 Everett H. Hopkins (1961), M.A., LL.D., Professor of Education
 Jerry F. Hough (1973), Ph.D., Professor of Political Science and Professor of Public Policy Sciences
 James S. House (1970), Ph.D., Assistant Professor of Sociology
 Alexander Hull (1962), Ph.D., Associate Professor of Romance Languages
 Allan S. Hurlburt (1956), Ph.D., Professor of Education
 William Hylander (1971), Ph.D., Assistant Professor of Anatomy
 Wallace Jackson (1965), Ph.D., Associate Professor of English
 Boi Jon Jaeger (1971), Ph.D., Associate Professor of Health Administration
 Hugo Jaurregui (1970), M.D., Ph.D., Assistant Professor of Pathology
 Peter W. Jeffs (1964), Ph.D., Professor of Chemistry
 Marianna Jenkins (1948), Ph.D., Professor of Art
 Bronislas de Leval Jezierski (1958), Ph.D., Associate Professor of Slavic Languages and Literatures
 Frans F. Jobsis (1964), Ph.D., Professor of Physiology
²⁸Sheridan Johns, III (1970), Ph.D., Associate Professor of Political Science
 Charles B. Johnson (1956), Ed.D., Associate Professor of Education
 Edward Johnson (1963), M.D., Professor of Physiology and Pharmacology
 Kurt Johnson (1971), Ph.D., Assistant Professor of Anatomy
 Terry W. Johnson, Jr. (1954), Ph.D., Professor of Botany
 William W. Johnston (1963), M.D., Professor of Pathology
 William Thomas Joines (1966), Ph.D., Associate Professor of Electrical Engineering

²¹Leave of absence, academic year, 1973-74.

²²Retired, February 28, 1973.

²³Leave of absence, academic year, 1973-74.

²⁴Sabbatical leave, spring semester, 1974.

²⁵Sabbatical leave, academic year, 1973-74.

²⁶Leave of absence, January 1, 1974 through August 31, 1975.

²⁷Sabbatical leave, fall semester, 1973.

²⁸Leave of absence, spring semester, 1974.

Wolfgang Karl Joklik (1968), D.Phil., James B. Duke Professor of Microbiology and Immunology
Buford Jones (1962), Ph.D., Associate Professor of English
Edward Ellsworth Jones (1953), Ph.D., Professor of Psychology
James Kalat (1971), Ph.D., Assistant Professor of Psychology
Henry Kamin (1948), Ph.D., Professor of Biochemistry
William G. Katzenmeyer (1967), Ed.D., Associate Professor of Education
Bernard Kaufman (1968), Ph.D., Associate Professor of Biochemistry
Thomas F. Keller (1959), Ph.D., Professor of Business Administration
Allen C. Kelley (1972), Ph.D., Professor of Economics
William N. Kelley (1968), M.D., Assistant Professor of Biochemistry
Van Leslie Kenyon, Jr. (1945), M.M.E., Professor of Mechanical Engineering
Alan C. Kerckhoff (1958), Ph.D., Professor of Sociology
Robert B. Kerr (1965), Ph.D., Professor of Electrical Engineering
Sung-Hou Kim (1970), Ph.D., Assistant Professor of Biochemistry
Thomas DeArman Kinney (1960), M.D., Professor of Pathology
Marcel Kinsbourne (1967), M.D., Lecturer in Psychology
Gary Kirk (1970), Ph.D., Assistant Professor of Physiology
Norman Kirshner (1956), Ph.D., Associate Professor of Biochemistry
Joseph Weston Kitchen, Jr. (1962), Ph.D., Associate Professor of Mathematics
Gordon K. Klintworth (1964), M.D., Ph.D., Professor of Pathology
Peter H. Klopfer (1958), Ph.D., Professor of Zoology
²⁹Kenneth R. Knoerr (1961), Ph.D., Professor of Forest Meteorology and Professor of Botany
J. Mailen Kootsey (1969), Ph.D., Assistant Professor of Physiology and Pharmacology
³⁰Allan Kornberg (1965), Ph.D., Professor of Political Science
Wesley A. Kort (1965), Ph.D., Associate Professor of Religion
David Paul Kraines (1970), Ph.D., Associate Professor of Mathematics
Paul Jackson Kramer (1931), Ph.D., James B. Duke Professor of Botany
Nicholas Michael Kredich (1968), M.D., Assistant Professor of Biochemistry
Irwin Kremen (1963), Ph.D., Assistant Professor of Psychology
Juanita M. Kreps (1955), Ph.D., James B. Duke Professor of Economics
William R. Krigbaum (1952), Ph.D., James B. Duke Professor of Chemistry
Arnold D. Krugman (1964), Ph.D., Lecturer in Psychology
³¹Magnus Jan Krynski (1966), Ph.D., Associate Professor of Slavic Languages and Literatures
Arthur J. Kuhn (1971), Ph.D., Assistant Professor of Business Administration
³²Wladyslaw W. Kulski (1963), Dr. Jur., James B. Duke Professor of Russian Affairs
Johannes A. Kyllstra (1965), M.D., Ph.D., Associate Professor of Physiology
³³Weston LaBarre (1946), Ph.D., James B. Duke Professor of Anthropology
Leon Lack (1965), Ph.D., Professor of Physiology and Pharmacology
³⁴Creighton Lacy (1953), Ph.D., Professor of Missions and Social Ethics
Martin Lakin (1958), Ph.D., Professor of Psychology
Richard L. Landeira (1970), Ph.D., Assistant Professor of Romance Languages
David L. Lange (1971), LL.B., Associate Professor of Public Policy Sciences
Karla Langedijk (1969), Ph.D., Lecturer in Art History
Thomas A. Langford (1956), Ph.D., Professor of Religion
Peter K. Lauf (1968), M.D., Associate Professor of Physiology and Assistant Professor of Immunology
Dan J. Laughhunn (1968), Ph.D., Associate Professor of Business Administration and Management Sciences
Bruce Lawrence (1971), Ph.D., Assistant Professor of Religion
Richard H. Leach (1955), Ph.D., Professor of Political Science
Harold E. Lebovitz (1959), M.D., Assistant Professor of Physiology
³⁵Jack A. Lees (1971), Ph.D., Assistant Professor of Mathematics
Robert Lefkowitz (1973), Ph.D., Assistant Professor of Biochemistry
Warren Lerner (1961), Ph.D., Professor of History
Harold Walter Lewis (1946), Ph.D., Professor of Physics
Melvyn Lieberman (1967), Ph.D., Assistant Professor of Physiology and Pharmacology
John L. Lievsay (1962), Ph.D., James B. Duke Professor of English
L. Sigfred Linderoth, Jr. (1965), M.E., Professor of Mechanical Engineering
Daniel A. Livingstone (1956), Ph.D., Professor of Zoology
Charles H. Lochmuller (1969), Ph.D., Assistant Professor of Chemistry
Gregory Lockhead (1965), Ph.D., Professor of Psychology

²⁹Sabbatical leave, fall semester, 1973.

³⁰Sabbatical leave, academic year, 1973-74.

³¹Sabbatical leave, spring semester, 1974.

³²Retired, August 31, 1973.

³³Sabbatical leave, spring semester, 1974.

³⁴Sabbatical leave, academic year, 1973-74.

³⁵Leave of absence, academic year, 1973-74.

James S. Loos (1972), Ph.D., Assistant Professor of Physics
 William Longley (1968), Ph.D., Assistant Professor of Anatomy
 Donald Loveland (1973), Ph.D., Professor of Computer Science
 John G. Lundberg (1970), Ph.D., Assistant Professor of Zoology
 William S. Lynn, Jr. (1954), M.D., Associate Professor of Biochemistry
 George W. Lynts (1965), Ph.D., Associate Professor of Geology
 John Nelson Macduff (1956), M.M.E., Professor of Mechanical Engineering
 Barry MacKichan (1970), Ph.D., Assistant Professor of Mathematics
 Lazaro J. Mandel (1972), Ph.D., Assistant Professor of Physiology
 Kenneth S. McCarty (1959), Ph.D., Professor of Biochemistry
 David R. McClay (1973), Ph.D., Assistant Professor of Zoology
 Joe M. McCord (1970), Ph.D., Associate Professor of Biochemistry
 James H. McElhaney (1973), Ph.D., Professor of Biomedical Engineering
 Marjorie McElroy (1970), Ph.D., Assistant Professor of Economics
 Patrick A. McKee (1969), M.D., Assistant Professor of Biochemistry
 John C. McKinney (1957), Ph.D., Professor of Sociology
 Thomas J. McManus (1961), M.D., Associate Professor of Physiology
 Andrew T. McPhail (1968), Ph.D., Professor of Chemistry
 George L. Maddox (1960), Ph.D., Professor of Sociology
 M. Stephen Mahaley (1965), M.D., Ph.D., Assistant Professor of Anatomy
 Edward P. Mahoney (1965), Ph.D., Associate Professor of Philosophy
 Steven Maier (1971), Ph.D., Assistant Professor of Business Administration
 Peter N. Marinos (1968), Ph.D., Professor of Electrical Engineering
 Sidney David Markman (1947), Ph.D., Professor of Art History and Archaeology
 David V. Martin (1962), Ed.D., Associate Professor of Education
³⁶Seymour Mauskopf (1964), Ph.D., Associate Professor of History
 Robert Arthur Maxwell (1971), Ph.D., Adjunct Professor of Pharmacology
 Elgin W. Mellow, Jr., (1965), Ph.D., Associate Professor of English
 Lorne Mendell (1968), Ph.D., Assistant Professor of Physiology
 Daniel B. Menzel (1971), Ph.D., Associate Professor of Pharmacology
 Louis John Metz (1970), Ph.D., Adjunct Associate Professor of Forest Soils
 Richard S. Metzgar (1962), Ph.D., Professor of Immunology
³⁷Johannes Horst Max Meyer (1959), D.Sc., Professor of Physics
 Eric Meyers (1969), Ph.D., Associate Professor of Religion
 Martin Miller (1970), Ph.D., Assistant Professor of History
 Elliott Mills (1968), Ph.D., Assistant Professor of Physiology
 William Mishler (1972), Ph.D., Assistant Professor of Political Science
³⁸Gerald Monsman (1965), Ph.D., Associate Professor of English
 John W. Moore (1961), Ph.D., Professor of Physiology
³⁹Lawrence C. Moore, Jr. (1966), Ph.D., Associate Professor of Mathematics
 Montrose J. Moses (1959), Ph.D., Professor of Anatomy
 Earl George Mueller (1945), Ph.D., Professor of Art
⁴⁰Bruce J. Muga (1967), Ph.D., Associate Professor of Civil Engineering
 Bruce Roy Munson (1970), Ph.D., Assistant Professor of Mechanical Engineering
⁴¹Roland E. Murphy (1967-68; 1971), S.T.D., Professor of Religion
 Francis Joseph Murray (1960), Ph.D., Professor of Mathematics
 George C. Myers (1968), Ph.D., Professor of Sociology
 Toshio Narahashi (1962-63; 1965), Ph.D., Professor of Pharmacology
⁴²Sydney Nathans (1966), Ph.D., Associate Professor of History
 Aubrey Willard Naylor (1952), Ph.D., James B. Duke Professor of Botany
 Thomas H. Naylor (1964), Ph.D., Professor of Economics and Professor of Computer Science
 Glenn Robert Negley (1946), Ph.D., Professor of Philosophy
 Henry Winston Newson (1948), Ph.D., James B. Duke Professor of Physics
 Francis Newton (1967), Ph.D., Professor of Latin in Classical Studies
 Charles Adam Nichol (1971), Ph.D., Adjunct Professor of Pharmacology
 Jack L. Nichols (1970), Ph.D., Assistant Professor of Microbiology
 Robert Bruce Nicklas (1965), Ph.D., Professor of Zoology
 Robert Niess (1971), Ph.D., Professor of Romance Languages
 Charles Edwin V. Nixon (1971), Ph.D., Assistant Professor of Classical Studies
 Loren Nolte (1966), Ph.D., Professor of Electrical Engineering and Professor of
 Biomedical Engineering

³⁶Leave of absence, spring semester, 1974.

³⁷Sabbatical leave, spring semester, 1974.

³⁸Sabbatical leave, spring semester, 1974.

³⁹Sabbatical leave, academic year, 1973-74.

⁴⁰Leave of absence, academic year, 1973-74.

⁴¹Sabbatical leave, academic year, 1973-74.

⁴²Sabbatical leave, spring semester, 1974.

Thomas T. Norton (1972), Ph.D., Assistant Professor of Psychology
 Richey Novak (1969), Ph.D., Associate Professor of Germanic Langouages
 Yasuhiko Nozaki (1962), Ph.D., Associate Professor of Biochemistry
 Holger O. Nygard (1960), Ph.D., Professor of English

⁴³John F. Oates (1967), Ph.D., Professor of Ancient History in Classical Studies
 Jean O'Barr (1970), Ph.D., Lecturer in Political Science
 William O'Barr (1969), Ph.D., Assistant Professor of Anthropology
 Walter D. Obrist (1956), Ph.D., Lecturer in Psychology
 William M. O'Fallon (1965), Ph.D., Assistant Professor of Mathematics
 Robert T. Osborn (1954), Ph.D., Professor of Religion
 Ronald W. Oppenheim (1973), Ph.D., Lecturer in Psychology
 Suydam Osterhout (1959), M.D., Ph.D., Professor of Microbiology
 Athos Ottolenghi (1959), M.D., Associate Professor of Physiology and Pharmacology
 Harry Ashton Owen, Jr. (1951), Ph.D., Professor of Electrical Engineering

⁴⁴George M. Padilla (1965), Ph.D., Associate Professor of Physiology
 David L. Paletz (1967), Ph.D., Associate Professor of Political Science
 Aubrey E. Palmer (1944), C.E., Associate Professor of Civil Engineering

⁴⁵Richard A. Palmer (1966), Ph.D., Associate Professor of Chemistry

⁴⁶Erdman B. Palmore (1967), Ph.D., Professor of Sociology
 William E. Parham (1972), Ph.D., R. J. Reynolds Professor of Chemistry
 Harold Talbot Parker (1939), Ph.D., Professor of History
 Harry Partin (1964), Ph.D., Associate Professor of Religion
 Merrill Lee Patrick (1964), Ph.D., Associate Professor of Computer Science
 Michael I. Pavlov (1960), Ph.D., Associate Professor of Russian Language
 William Bernard Peach (1951), Ph.D., Professor of Philosophy
 George Wilbur Pearsall (1964), Sc.D., Professor of Mechanical Engineering
 Talmage Lee Peele (1939), M.D., Professor of Anatomy and Lecturer in Psychology
 Ronald D. Perkins (1968), Ph.D., Associate Professor of Geology
 Anton Peterlin (1962), Ph.D., Adjunct Professor of Chemistry
 Russell J. Petersen (1971), Ph.D., Assistant Professor of Business Administration
 David W. Peterson (1973), Ph.D., Professor of Business Administration
 Olan Lee Petty (1952), Ph.D., Professor of Education
 Leland R. Phelps (1961), Ph.D., Professor of German

⁴⁷Jane Philpott (1951), Ph.D., Professor of Botany
 Orrin Pilkey (1965), Ph.D., Professor of Geology
 Theo Clyde Pilkington (1958), Ph.D., Professor of Electrical Engineering and Professor of Biomedical Engineering

Colin G. Pitt (1969), Ph.D., Adjunct Associate Professor of Chemistry
 Robert A. Pittillo, Jr. (1968), Ed.D., Associate Professor of Education
 Jacques C. Poirier (1955), Ph.D., Professor of Chemistry
 Ned Allen Porter (1969), Ph.D., Assistant Professor of Chemistry
 Travis Porter (1972), J.D., Adjunct Professor of Business Administration
 Herbert S. Posner (1968), Ph.D., Clinical Associate Professor of Pharmacology
 William H. Poteat (1960), Ph.D., Professor of Christianity and Culture
 Philip Pratt (1966), M.D., Professor of Pathology
 Richard Lionel Predmore (1950), D.M.L., Professor of Romance Languages
 Jack J. Preiss (1959), Ph.D., Professor of Sociology
 Richard A. Preston (1961), Ph.D., William K. Boyd Professor of History
 David Eugene Price (1973), Ph.D., Associate Professor of Political Science and Associate Professor of Public Policy Sciences

⁴⁸James Ligon Price, Jr. (1952), Ph.D., Professor of Religion
 Louis DuBose Quin (1956), Ph.D., Professor of Chemistry
 Naomi Quinn (1972), Ph.D., Assistant Professor of Anthropology
 Jill Raitt (1973), Ph.D., Associate Professor of Religion
 K. V. Rajagopalan (1966), Ph.D., Associate Professor of Biochemistry
 Charles William Ralston (1954), Ph.D., Professor of Forest Soils
 Dietolf Ramm (1969), Ph.D., Assistant Professor of Computer Science
 Dale B. J. Randall (1957), Ph.D., Professor of English
 Norman B. Ratliff (1968), M.D., Associate Professor of Pathology
 Michael Charles Reed (1974), Ph.D., Professor of Mathematics
 Michael Kay Reedy (1969), M.D., Associate Professor of Anatomy
 Edmund Reiss (1967), Ph.D., Professor of English
 Eugene M. Renkin (1963), Ph.D., Professor of Physiology

⁴³Sabbatical leave, academic year, 1973-74.

⁴⁴Sabbatical leave, July 1, 1972 through March 30, 1973.

⁴⁵Sabbatical leave, spring semester, 1974.

⁴⁶Sabbatical leave, August 1, 1973 through December 31, 1973.

⁴⁷Sabbatical leave, fall semester, 1973.

⁴⁸Sabbatical leave, academic year, 1973-74.

Jacqueline A. Reynolds (1969), Ph.D., Assistant Professor of Anatomy and Associate Professor of Biochemistry

David Claude Richardson (1969), Ph.D., Assistant Professor of Biochemistry

Lawrence Richardson, Jr. (1966), Ph.D., Professor of Latin in Classical Studies

Eberhard Karl Riedel (1971), Ph.D., Assistant Professor of Physics

Kent J. Rigsby (1971), Horvord Society of Fellows, Assistant Professor of Classics

Nathan Russell Roberson (1963), Ph.D., Associate Professor of Physics

George W. Roberts (1971), Ph.D., Associate Professor of Philosophy

Verne Louis Roberts (1973), Ph.D., Adjunct Professor of Mechanical Engineering

J. David Robertson (1966), M.D., Ph.D., Professor of Anatomy

Charles K. Robinson (1961), Ph.D., Associate Professor of Religion

⁴⁹George Robinson (1971), Ph.D., Assistant Professor of Psychology

Hugh G. Robinson (1964), Ph.D., Professor of Physics

Hermann R. Robl (1959-64; 1966), Ph.D., Adjunct Professor of Physics

Theodore Ropp (1938), Ph.D., Professor of History

Carl M. Rose, Jr. (1967), Ph.D., Assistant Professor of Physics

Gerald Martin Rosen (1972), Ph.D., Assistant Professor of Physiology and Pharmacology

David Rosenthal (1969), Ph.D., Adjunct Associate Professor of Chemistry

Myron Rosenthal (1969), Ph.D., Assistant Professor of Physiology

David J. Ross (1972), Ph.D., Assistant Professor of Philosophy

Wendell F. Rosse (1966), M.D., Associate Professor of Immunology

Susan Roth (1973), Ph.D., Assistant Professor of Psychology

Donald Francis Roy (1950), Ph.D., Professor of Sociology

Clyde de Loache Ryals (1973), Ph.D., Professor of English

Harvey J. Sage (1964), Ph.D., Associate Professor of Biochemistry and Assistant Professor of Pathology

⁵⁰Lester M. Salamon (1973), Ph.D., Assistant Professor of Political Science and Assistant Professor of Public Policy Sciences

Herman Salinger (1955), Ph.D., Professor of German

Jay S. Salkin (1969), Ph.D., Assistant Professor of Economics

John V. Salzano (1956), Ph.D., Associate Professor of Physiology

⁵¹Charles Richard Sanders (1937), Ph.D., Professor of English

David H. Sanford (1970), Ph.D., Associate Professor of Philosophy

Lloyd Saville (1946), Ph.D., Professor of Economics

Saul M. Schanberg (1967), M.D., Ph.D., Professor of Pharmacology

Richard M. Scheffler (1973), Ph.D., Adjunct Assistant Professor of Public Policy Sciences

Harold Schiffman (1963), Ph.D., Professor of Psychology

Knut Schmidt-Nielsen (1952), Mag.Sc., Dr.Phil., James B. Duke Professor of Physiology in the Department of Zoology

Eugene S. Schneller (1973), Ph.D., Assistant Professor of Sociology

Ernest Schoffeniels (1969), M.D., Adjunct Professor of Physiology and Pharmacology

David W. Schamberg (1968), Ph.D., Assistant Professor of Physiology

James M. Schooler, Jr. (1970), Ph.D., Assistant Professor of Physiology

Anne Firor Scott (1961), Ph.D., Professor of History

David W. Scott (1971), Ph.D., Assistant Professor of Immunology

William E. Scott (1958), Ph.D., Professor of History

Richard A. Scoville (1961), Ph.D., Associate Professor of Mathematics

Richard B. Searles (1965), Ph.D., Associate Professor of Botany

H. F. Seigler (1967), M.D., Associate Professor of Immunology

John Shelburne (1973), Ph.D., Assistant Professor of Pathology

Marion L. Shepard (1967), Ph.D., Associate Professor of Mechanical Engineering

Joseph R. Shoenfield (1952), Ph.D., Professor of Mathematics

William Derek Shows (1967), Ph.D., Assistant Professor of Medical Psychology

R. Baird Shuman (1962), Ph.D., Professor of Education

Lewis M. Siegel (1966), Ph.D., Assistant Professor of Biochemistry

Bernard Silberman (1967), Ph.D., Professor of History

Ida Simpson (1967), Ph.D., Associate Professor of Sociology

⁵²William H. Simpson (1930), Ph.D., Professor of Political Science

Theodore Alan Slotkin (1971), Ph.D., Assistant Professor of Physiology

D. Moody Smith (1965), Ph.D., Professor of Religion

David A. Smith (1962), Ph.D., Associate Professor of Mathematics

Donald S. Smith, II (1959), M.H.A., Assistant Professor of Health Administration

Grover C. Smith (1952), Ph.D., Professor of English

Harmon Smith (1959), Ph.D., Professor of Moral Theology

⁴⁹Leave of absence, academic year, 1973-74.

⁵⁰Leave of absence, fall semester, 1973.

⁵¹Retired, August 31, 1973

⁵²Retired, August 31, 1973.

Joel Smith (1958), Ph.D., Professor of Sociology
 Peter Smith (1959), Ph.D., Professor of Chemistry
 Ralph Smith (1970), Ph.D., Assistant Professor of Microbiology
 George G. Somjen (1963), M.D., Professor of Physiology and Lecturer in Psychology
⁵³Joachim R. Sommer (1957), M.D., Associate Professor of Pathology
 Bernard F. Spielvogel (1972), Ph.D., Adjunct Associate Professor of Chemistry
 George Spooner (1965), Ph.D., Assistant Professor of Pathology
⁵⁴Thomas Arthur Spragins, Jr. (1967), Ph.D., Assistant Professor of Political Science
 John Spragins (1973), Ph.D., Adjunct Associate Professor of Computer Science
⁵⁵Olaf Stackelberg (1963), Ph.D., Associate Professor of Mathematics
⁵⁶John E. R. Staddon (1967), Ph.D., Professor of Psychology
 William J. Stambaugh (1961), Ph.D., Professor of Forest Pathology
 Dennis Keith Stanley (1961), Ph.D., Associate Professor of Classical Studies
 Charles Franklin Starmer, Jr. (1966), Ph.D., Associate Professor of Computer Science
 Howard Steinman (1970), Ph.D., Associate in Biochemistry
 David Curtis Steinmetz (1971), Th.D., Associate Professor of Religion
⁵⁷Henry R. Stern (1968), Ph.D., Assistant Professor of German
 Philip Stewart (1972), Ph.D., Associate Professor of Romance Languages
 Donald E. Stone (1963), Ph.D., Professor of Botany
 Boyd R. Strain (1969), Ph.D., Associate Professor of Botany
 Victor H. Strandberg (1966), Ph.D., Associate Professor of English
 Howard Austin Strobel (1948), Ph.D., Professor of Chemistry
 Henry L. Sublett, Jr. (1962), Ed.D., Associate Professor of Education
 J. Bolling Sullivan (1970), Ph.D., Assistant Professor of Biochemistry
 Elizabeth Read Sunderland (1939-42; 1943), Ph.D., Professor of Art
 John Sutherland (1969), Ph.D., Assistant Professor of Zoology
 John Sykes (1968), Ph.D., Associate Professor of Physics
 Charles Tanford (1959), Ph.D., James B. Duke Professor of Physical Biochemistry
⁵⁸John J. TePaske (1967), Ph.D., Professor of History
 Marcel Tetel (1960), Ph.D., Professor of Romance Languages
 Larry W. Thompson (1961), Ph.D., Lecturer in Psychology
 Fredrick L. Thurstone (1967), Ph.D., Professor of Electrical Engineering and Professor of Biomedical Engineering
 Edward A. Tiryakian (1965), Ph.D., Professor of Sociology
 Craig Tisher (1969), M.D., Assistant Professor of Pathology
 Daniel C. Tosteson (1961), M.D., James B. Duke Professor of Physiology
⁵⁹Vladimir G. Treml (1967), Ph.D., Professor of Economics
 Richard Trilling (1970), Ph.D., Assistant Professor of Political Science
 James Nardin Truesdale (1930), Ph.D., Professor of Greek
 Vance Tucker (1964), Ph.D., Professor of Zoology
⁶⁰Arlin Turner (1953), Ph.D., Professor of English
 Richard L. Tuthill (1953), Ed.D., Professor of Economic Geography
 Senol Utlu (1970), Sc.D., Professor of Civil Engineering
⁶¹Arturo Valenzuela (1970), Ph.D., Assistant Professor of Political Science
 Thomas C. Vanaman (1970), Ph.D., Assistant Professor of Microbiology
 John M. Vernon (1966), Ph.D., Professor of Economics
 Aleksandar Sedmak Vesic (1964), D.Sc., J. A. Jones Professor of Civil Engineering
 P. Arne Vesilind (1970), Ph.D., Assistant Professor of Civil Engineering
 Elia E. Villanueva (1961), M.A., Assistant Professor of Physical Therapy
 Patrick R. Vincent (1954), Ph.D., Associate Professor of Romance Languages
 F. Stephen Vogel (1961), M.D., Professor of Pathology
 Steven Vogel (1966), Ph.D., Associate Professor of Zoology
 Fred M. Vukovich (1967), Ph.D., Adjunct Associate Professor of Forest Meteorology
 Howard C. Wachtel (1968), Ph.D., Associate Professor of Biomedical Engineering and Assistant Professor of Physiology
 Stephen A. Wainwright (1964), Ph.D., Associate Professor of Zoology
 William D. Walker (1971), Ph.D., Professor of Physics
 Andrew G. Wallace (1971), Ph.D., Assistant Professor of Physiology
 Lise Wallach (1970), Ph.D., Lecturer in Psychology

⁵³Sabbatical leave, January 1, 1973 through December 31, 1973.

⁵⁴Leave of absence, spring semester, 1974.

⁵⁵Sabbatical leave, spring semester, 1974.

⁵⁶Sabbatical leave, academic year, 1973-74.

⁵⁷Leave of absence, fall semester, 1973.

⁵⁸Sabbatical leave, spring semester, 1974.

⁵⁹Sabbatical leave, spring semester, 1974.

⁶⁰Sabbatical leave, academic year, 1973-74.

⁶¹Leave of absence, spring semester, 1974.

Michael Wallach (1962), Ph.D., Professor of Psychology
 Richard L. Walter (1962), Ph.D., Associate Professor of Physics
 Paul P. Wang (1968), Ph.D., Associate Professor of Electrical Engineering
 Calvin L. Ward (1952), Ph.D., Associate Professor of Zoology
 Frances Ellen Ward (1969), Ph.D., Associate Professor of Microbiology and Immunology
 Bruce W. Wardroppe (1962), Ph.D., William Hones Wonnemaker Professor of Romance
 Languages
 Seth L. Warner (1955), Ph.D., Professor of Mathematics
 Richard Lyness Watson, Jr. (1939), Ph.D., Professor of History
 Katharine Way (1968), Ph.D., Adjunct Professor of Physics
 Robert E. Webster (1970), Ph.D., Associate Professor of Biochemistry
 Eliot Weintraub (1970), Ph.D., Associate Professor of Economics
 Morris Weisfeld (1967), Ph.D., Professor of Mathematics
 Henry Weitz (1950), Ed.D., Professor of Education
⁶²Bruce A. Wells (1964), M.S.E.E., Associate Professor of Electrical Engineering
 Richard L. Wells (1962), Ph.D., Professor of Chemistry
 Paul Welsh (1948), Ph.D., Professor of Philosophy
 Robert W. Wheat (1956), Ph.D., Associate Professor of Microbiology and Assistant Professor of
 Biochemistry
 Charles W. White (1970), Ph.D., Assistant Professor of Psychology
 Richard A. White (1963), Ph.D., Professor of Botany
 Henry Wilbur (1973), Ph.D., Assistant Professor of Zoology
 Karl Milton Wilbur (1946), Ph.D., James B. Duke Professor of Zoology
 Robert L. Wilbur (1957), Ph.D., Professor of Botany
 Pelham Wilder, Jr. (1949), Ph.D., Professor of Chemistry
 William E. Wilkinson (1967), Ph.D., Assistant Professor of Mathematics
 Hilda Pope Willett (1948), Ph.D., Professor of Microbiology
 George W. Williams (1957), Ph.D., Professor of English
 Leland Williams (1970), Ph.D., Adjunct Associate Professor of Computer Science
 William Hailey Willis (1963), Ph.D., Professor of Greek in Classical Studies
 James F. Wilson (1967), Ph.D., Associate Professor of Civil Engineering
 James W. Wilson (1967), M.D., Ph.D., Assistant Professor of Pathology
 John Wilson (1968), Ph.D., Associate Professor of Sociology
 Thomas George Wilson (1959), Sc.D., Professor of Electrical Engineering
⁶³Cliff W. Wing, Jr. (1965), Ph.D., Associate Professor of Psychology
 Orval S. Wintermute (1958), Ph.D., Associate Professor of Religion
 Ronald Witt (1971), Ph.D., Associate Professor of History
⁶⁴Benjamin Wittels (1961), M.D., Professor of Pathology
 Myron Wolbarsht (1968), Ph.D., Professor of Biomedical Engineering, Associate Professor of
 Physiology, and Lecturer in Psychology
 Max A. Woodbury (1966), Ph.D., Professor of Computer Science
 Donald Wright (1967), Ph.D., Assistant Professor of Mechanical Engineering
 James E. Wuenscher (1970), Ph.D., Assistant Professor of Forest Ecology
 David O. Yandle (1967), Ph.D., Associate Professor of Forest Mathematics
 William P. Yohe (1958), Ph.D., Professor of Economics
 Charles R. Young (1954), Ph.D., Professor of History
 Franklin W. Young (1944-50; 1968), Ph.D., Amos Rodger Keorns Professor of New Testament
 and Pastoral Studies in Religion
 Julie Zalkind (1973), Ph.D., Assistant Professor of Business Administration
 Peter Zwadyk (1971), Ph.D., Assistant Professor of Pathology
 Hans J. Zweerink (1970), Ph.D., Associate Professor of Microbiology

Emeritus Professors

Katharine May Banham (1946), Ph.D., Professor Emeritus of Psychology
 Charles A. Baylis (1952), Ph.D., Professor Emeritus of Philosophy
 Joseph W. Beard (1937), M.D., James B. Duke Professor Emeritus of Virology
 Mary L. C. Bernheim (1930), Ph.D., Professor Emeritus of Biochemistry
 Lucius Aurelius Bigelow (1929), Ph.D., Professor Emeritus of Chemistry
 Edward Claude Bolmeier (1948), Ph.D., Professor Emeritus of Education
 Francis Ezra Bowman (1945), Ph.D., Professor Emeritus of English
 Benjamin Boyce (1950), Ph.D., James B. Duke Professor Emeritus of English
 Benjamin Guy Childs (1924), M.A., Professor Emeritus of Education
 Kenneth Willis Clark (1931), Ph.D., D.D., Professor Emeritus of New Testament

⁶²Retired, August 31, 1973.

⁶³Sabbatical leave, academic year, 1973-74.

⁶⁴Leave of absence, September 1, 1972 through June 30, 1973.

Frederick A. G. Cowper (1918), Ph.D., Professor Emeritus of Romance Languages
John S. Curtiss (1945), Ph.D., James B. Duke Professor Emeritus of History
Bingham Dai (1943), Ph.D., Professor Emeritus of Psychology
Neal Dow (1934), Ph.D., Professor Emeritus of Romance Languages
George Sharp Eadie (1930), Ph.D., Professor Emeritus of Physiology and Pharmacology
Howard Easley (1930), Ph.D., Associate Professor Emeritus of Education
William Whitfield Elliott (1925), Ph.D., Professor Emeritus of Mathematics
Allan H. Gilbert (1920), Ph.D., Professor Emeritus of English
Clarence Gohdes (1930), Ph.D., James B. Duke Professor Emeritus of English
Irving Emery Gray (1930), Ph.D., Professor Emeritus of Zoology
Paul M. Gross (1919), Ph.D., William Howell Pegram Professor Emeritus of Chemistry
Charles Cleveland Hatley (1917), Ph.D., Professor Emeritus of Physics
Duncan Charteris Hetherington (1930), M.D., Ph.D., Professor Emeritus of Anatomy
Calvin Bryce Hoover (1925), Ph.D., James B. Duke Professor Emeritus of Economics
Jay Broadus Hubbel (1927), Ph.D., Professor Emeritus of English
Wanda S. Hunter (1947), Ph.D., Professor Emeritus of Zoology
William H. Irving (1936), B.A. (Oxon.), Ph.D., Professor Emeritus of English
Brady Rimbey Jordan (1927), Ph.D., Professor Emeritus of Romance Languages
Helen L. Kaiser (1943), R.P.T., Professor Emeritus of Physical Therapy
William Thomas Laprade (1909), Ph.D., Professor Emeritus of History
Charles Earl Landon (1926), Ph.D., Professor Emeritus of Economics
John Tate Lanning (1927), Ph.D., James B. Duke Professor Emeritus of History
Alan Krebs Manchester (1929), Ph.D., Professor Emeritus of History
Ernest William Nelson (1926), Ph.D., Professor Emeritus of History
Walter McKinley Nielsen (1925), Ph.D., James B. Duke Professor Emeritus of Physics
James G. Osborne (1961), B.S., Professor Emeritus of Forestry
Robert Leet Patterson (1945), Ph.D., Professor Emeritus of Philosophy
Lewis Patton (1926), Ph.D., Professor Emeritus of English
Harold Sanford Perry (1932), Ph.D., Professor Emeritus of Botany
Ray C. Petry (1937), Ph.D., LL.D., James B. Duke Professor Emeritus of Church History
Robert Stanley Rankin (1927), Ph.D., Professor Emeritus of Political Science
Mabel F. Rudisill (1948), Ph.D., Professor Emeritus of Education
David Tillerson Smith (1930), M.D., Litt.D., James B. Duke Professor Emeritus of Microbiology
H. Shelton Smith (1931), Ph.D., James B. Duke Professor Emeritus of Religion
Joseph John Spengler (1934), Ph.D., James B. Duke Professor Emeritus of Economics
Lionel Stevenson (1955), Ph.D., James B. Duke Professor Emeritus of English
William Franklin Stinespring (1936), Ph.D., Professor Emeritus of Old Testament and Semitics
W. A. Stumpf (1948), Ph.D., Professor Emeritus of Education
Edgar Tristram Thompson (1935), Ph.D., Professor Emeritus of Sociology
Clement Vollmer (1926), Ph.D., Professor Emeritus of German
Warren Chase Vosburgh (1928), Ph.D., Professor Emeritus of Chemistry
Loring Baker Walton (1929), Lic. es L., Ph.D., Professor Emeritus of Romance Languages
Charles Eugene Ward (1927), Ph.D., Professor Emeritus of English
Robert Renbert Wilson (1925), Ph.D., LL.D., James B. Duke Professor Emeritus of Political Science
Frederick Adolphus Wolf (1927), Ph.D., James B. Duke Professor Emeritus of Botany
Robert Hilliard Woody (1929), Ph.D., Professor Emeritus of History





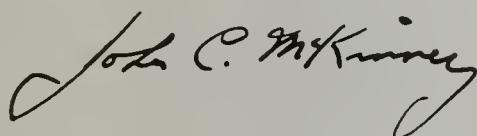
To the Prospective Graduate Student at Duke University

Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report:

The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise of futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.

Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his "original" research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.



John C. McKinney
Dean of the Graduate School



1

Program Information

Degrees Offered

The Graduate School of Duke University now offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Hospital Administration (M.H.A.), Master of Business Administration (M.B.A.), Doctor of Philosophy (Ph.D.), and Doctor of Education (Ed.D.).

The Master's Degrees

To be considered as a candidate for a master's degree (A.M., M.S., M.Ed., M.A.T., M.H.A., M.B.A.), the graduate student must (1) have made passing grades in the first 12 units of course work, (2) have made a grade of *G* or *E* on at least 3 units of this work, and (3) have received the approval of the major department (or in the case of the M.A.T., of the supervisory committee).

Residence Requirements. Candidates for all master's degrees must spend, as a minimum, one full academic year, or its equivalent in summer session terms, in residence at Duke University. Those who wish to complete their degrees wholly in the summer session must be in residence for five terms. Three terms are held each summer. Depending upon the degree program pursued and the individual student himself, additional time frequently proves necessary. (See section on Residence under Academic Regulations.)

Transfer of Graduate Credits. Under certain circumstances a maximum credit of 6 units may be allowed for graduate courses completed elsewhere. Units from other institutions will be transferred only if the student has received for them a grade of *B* (or its equivalent) or better. In any case, the transfer of graduate credit does not reduce the required minimum registration for a master's degree at Duke. In planning a master's program, a student who wishes to transfer up to 6 units into his program must, nevertheless, register at Duke for units equivalent to the number he is transferring.

With the approval of both the student's major department and the Dean of the Graduate School, a student who is granted such transfer credit may be permitted to register for as much as 12 units of thesis research instead of the usual 6 units. As another option, he may take as much as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level. In no case will credit be allowed for extension or correspondence courses.

Credit for graduate courses taken at Duke by a student (not undergraduate or nondegree) before his admission to the Graduate School may be carried over into a graduate degree program if: (1) the action is recommended by the student's director of graduate studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better.

Time Limits for Completion of Master's Degrees. The master's degree candidate who is in residence for consecutive academic years should complete all requirements for the degree within two calendar years from the date of his first registration in the Graduate School. Any candidate must complete all requirements within six calendar years of his first registration.

To be awarded a degree in May, the student must have completed all requirements, including the recording of transfer credit, by the last day of the final examination period. If a thesis is one of the requirements, it must be submitted to the Graduate School Office by April 15. Candidates desiring to have their degrees conferred on September 1 must have completed all requirements as of the final day of the Duke University summer session. A candidate completing degree requirements after that date will have his degree conferred at the following May Graduation Exercises. (Transfer of credit for work completed at other universities must be recorded by September 1.)

The Thesis. The thesis should demonstrate the student's ability to collect, arrange, interpret, and report pertinent material on his special research problem. Although a publishable document is not required, the thesis must be written in an acceptable style and should exhibit the student's competence in scholarly procedures. Requirements of form are set forth in the Duke University Guide for the Preparation of Theses and Dissertations.

Recommendation for Teacher Certification. Elementary school teachers who already hold certificates and who desire the recommendation of Duke University for a graduate teaching certificate must include in their master's program a minimum of 12 units in subjects ordinarily taught in elementary school and 12 units in education courses designed to improve them as elementary teachers. Secondary school teachers must include in their program a minimum of 18 units in their teaching fields and 6 units in courses in education designed to improve them as secondary school teachers.

MASTER OF ARTS

The Master of Arts degree may be earned either with or without presentation of a thesis. Whether or not a student writes a thesis, however, certain general requirements must be met. If the master's degree requirements are not specified in the departmental heading of this Bulletin, a prospective student should write directly to the appropriate director of graduate studies.

Prerequisites. As prerequisites to graduate study in his major subject, the student must have completed a minimum of 24 semester hours—normally 12 semester hours of approved college courses in that subject and 12 additional semester hours in that subject or in related work. Since some departments require more than 12 semester hours, the student should read carefully the special requirements listed by his major department, which are included as headnotes to the course offerings in this Bulletin.

Language Requirements. The Graduate School requires no foreign language for the master's degree. Certain departments, however, do have a foreign language requirement for their master's program. Any such requirement must be satisfied before the master's examination is taken. (See departmental headnotes and the appropriate section in the Chapter on Registration and Regulations.)

Major and Related Subjects. In his graduate work the student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in the major subject. A minimum of 6 units must be in a minor subject or related fields which are approved by his major department. The remaining 6 units of the required 24 may be taken in either the major or in related fields approved by the major department and by the Dean of the Graduate School. The nature of the additional 6 units for which he must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., these last 6 units are earned either with successful submission of the thesis or with such other courses or academic exercises as are approved by the student's department. (See below.) Earned credit for the degree totals a minimum of 30 units.

Completing the Program with Thesis. All basic requirements for preparing the thesis are described in the Guide for the Preparation of Theses and Dissertations, available in the Graduate School Office.

Four typewritten copies of the thesis bound in snap binders secured through the Graduate School Office must be submitted in an approved form to the Dean of the Graduate School on or before April 15 for a May degree, or August 15 for a September degree, and at least one week before the scheduled date of the student's examination. The copies will then be distributed by the student to the several members of the examining committee. Two copies for the library and one for the adviser will be bound by the Ruzicka Bindery, upon payment of a fee of \$5.00 per volume. The student should state whether or not he wishes more than three copies so bound.

Completing the Program without Thesis. The options with which a Master of Arts degree may be completed without presentation of a thesis are determined by the individual departments. Normally a student's committee makes its decision on his degree program after he has completed at least 9 units of graded course work. Beyond the 24 units required in major or related course work, 6 units may be earned either with additional course work or with other equivalent academic exercises approved by the student's department and committee. Such academic exercises might include an additional 3 units of graded course work supplemented, for example, by the following: (1) passing an oral examination on a three- to five-page research prospectus, plus a substantial bibliography on a topic within the student's major field, or (2) successful submission to the committee of two carefully revised term papers, preferably written originally for different instructors and originally earning a grade of G or higher. In any case, the student's total minimum registration will be for 30 units of work, followed by a final examination (see below).

The Examining Committee and the Examination. The instructor who directs the student's program appoints an examining committee composed of himself and two other members of the graduate faculty, one of whom must be from a department other than that of the major. If the student has been permitted to take related work within the major department, however, the third member may be chosen from within the department. Nominations for membership on this committee are submitted for approval to the Dean of the Graduate School at least one week preceding the final examination.

The student's committee administers the examination and certifies whether the student has passed or failed by signing the card provided for this

purpose by the Graduate School Office. This card is used to indicate completion of all requirements for the degree. If a thesis is presented, the committee also signs all copies of the thesis, and the candidate then returns the original, the first two copies, and any other copies he wishes bound by Ruzicka, to the Dean of the Graduate School, who has them sent to the University Library.

Filing the Intention to Graduate. On or before February 1 for a May degree or on or before August 1 for a September degree, the student must file in the Office of the Graduate School, on the official form, a declaration of intention to graduate. If degree requirements have been met before the deadlines above, the intention to graduate must be filed one month before the final examination. The declaration of intention gives the title of the thesis or specifies the alternative academic exercises on which the degree candidate will be examined. The declaration must have the approval of the director of graduate studies in the major department, and of the student's committee chairman.

MASTER OF SCIENCE

The degree of Master of Science is offered in various areas, including the following: forestry, geology, management sciences, pathology, physical therapy, statistics and computing, and four fields of engineering—biomedical, civil, electrical, and mechanical.

Prerequisites. A bachelor's degree is a prerequisite for the M.S. degree. All departments offering an M.S. degree will admit students from allied fields provided they have satisfactory scientific and mathematical backgrounds.

Language Requirement. There is no general foreign language requirement for students in the Master of Science degree programs.

Other Degree Requirements. Specific requirements vary according to the department. Please consult the section on Courses of Instruction for information concerning prerequisites, minimum units required, and major and related work.

Thesis and Examination. Some departments require a thesis. All departments require an examination. The regulations and options for theses and other means of completing the program, as well as the provisions for examination and an examining committee, are the same as the requirements for the Master of Arts degree discussed in the previous section.

MASTER OF EDUCATION

Prerequisites. The Ed.D. degree is designed for persons intending to pursue a career in professional education. No specific undergraduate major is required for participation in graduate studies leading to this degree, but the student must have earned a bachelor's degree which includes a program related to his professional goals.

Before the degree is conferred, the student must have had one year of experience in professional education or have included in his program 6 units of practicum, internship, and/or field experience or have met certification requirements by doing supervised student teaching in an accredited school.

Major and Related Subjects. In his graduate work the student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in the departmental major (administration, supervision, counseling, elementary education, secondary education, higher education, reading, teaching the emotionally disturbed, and other approved programs offered by the department). A minimum of 6 units must be in a minor subject or related areas within the department. The remaining 6 units of the required 24 may be taken in either the major or in related subjects. The nature

of the additional 6 units for which the student must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., the additional 6 units may be earned either by submitting a successful thesis or by completing courses in major and related subjects. A minimum of 30 units of earned credit is required for the degree.

Completing the Program with Thesis. The regulations governing the thesis are the same as those for the A.M. degree.

Completing the Program without the Thesis. Toward the end of the term in which the student completes his course work, he must pass a comprehensive examination on his departmental major. The examinations shall be prepared and conducted by the instructors of the student's major as designated by the Director of Graduate Studies of the Department of Education.

MASTER OF ARTS IN TEACHING

Prerequisites. The M.A.T. degree is designed for teachers already in service and for recent graduates of liberal arts colleges who wish to teach in a public school, private school, or junior college.

A student should normally have completed a minimum of 12 semester hours in his proposed major subject and an additional 12 semester hours in that or related subjects. Should a student wish to undertake a graduate major different from his undergraduate major, the prerequisites may be modified upon the recommendation of the student's committee and the approval of the Dean of the Graduate School.

Degree Programs. Either of two programs may be arranged, in consultation with the student's committee.

1. A major in education of 18 to 24 units and 12 to 18 units in non-education courses (for students seeking certification); a total of 36 units.

2. A major in non-education courses of 18 to 24 units and 6 to 12 units in education (for students already certified); a total of 30 units.

The non-education courses are to be taken in one or more subjects ordinarily taught in the secondary schools. The amount and distribution of this work will be determined by the needs of the individual student. A combined major in biological sciences or in physical sciences is possible in this program. Teachers who have already completed certification requirements must major in a teaching field in their Master of Arts in Teaching program. Students who have not completed certification requirements must major in education.

The Master of Arts in Teaching may be earned with or without the presentation of a thesis. If a student, in consultation with his committee, elects to present a thesis, 6 units of the total of 30 units required will be allotted to thesis research. He will then be required to complete 24 units of course credits. The regulations governing the thesis are the same as those for the A.M. degree with thesis. Candidates for the M.A.T. degree who have not had teaching experience are required to take Education 216 and either 215 or 315, in which case a minimum of 36 units is required.

The Committee. Each candidate for the degree will be assigned a committee, appointed by the director of graduate studies in the major department or area. This committee will consist of three members, at least one of whom will be from the Department of Education, and at least one from another department. The chairman of the committee will normally be chosen from the department of the major.

MASTER OF HOSPITAL ADMINISTRATION

The Department of Health Administration offers a curriculum for graduate students interested in the field of health services management. It is de-



signed primarily for those who seek ultimately to assume major leadership roles in all types of organizations and programs that involve the provision of health services, whether in public or private settings.

The basic Master of Hospital Administration program is designed around a core of courses in health services and the management sciences, with electives in the behavioral sciences. The student also selects one of four concentrations for in-depth study: finance, personnel, planning, or information management. The academic portion, which includes a rotating practicum, is of five continuous semesters in length. Upon completing the academic portion of the curriculum, the student usually takes a 12-month individually tailored rotating residency during which he receives a stipend. (Students with prior experience may petition for a waiver of the residency requirement.)

Students with any undergraduate major may apply. One year of calculus at the college level is the only prerequisite, and a special course at the University is available each summer for students whose preparation in mathematics is inadequate or out of date.

MASTER OF BUSINESS ADMINISTRATION

Prerequisites. The M.B.A. program is designed for students whose undergraduate work included at least one year of calculus and an educational background adequate to enable rigorous analysis. Undergraduate majors in the physical and biological sciences, mathematics, engineering, and the social sciences usually are well suited for the program. The M.B.A. program is designed to provide a thorough foundation in the concepts and theory that underlie the design, operation, and control of modern complex organizations.

Degree Program. The M.B.A. program contains a prescribed core of courses dealing with tools of analysis and the fundamental theoretical foundations for demanding administrative practice. In addition, each candidate elects a set of courses to prepare more specifically for his chosen professional practice.

The M.B.A. requires four semesters of full-time work totaling 64 units of graduate course credit. (See the Business Administration section under Courses of Instruction for a more detailed description of the degree requirements.) The M.B.A. program has neither a language nor a thesis requirement. No formal minor subject is required. A project in administrative research and formal writing is required in the fourth semester, and is described in the list of courses as the practicum.

The Doctor's Degrees

DOCTOR OF PHILOSOPHY

The Ph.D. degree is essentially a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not be sufficient for attaining this degree. The granting of the Ph.D. degree is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

Requirements. The formal requirements for the Ph.D. degree are as follows: (1) major or related courses, (2) foreign language(s) in most departments, (3) supervisory committee for program of study, (4) residence, (5) preliminary examination, (6) dissertation, and (7) final examination. In order to be considered for candidacy for the Ph.D. degree, the student must have passing grades in all of his course work, and on at least 9 units of this course work he must have made a grade of G or better.

Foreign Languages. A reading knowledge of one foreign language, ancient or modern, is required by the Graduate School in almost all departments. In a few departments, however, a language is not required. In others, a particular language is specified, and in still others more than one language may be required. If the language requirement is not specified in the departmental heading of this Bulletin, a prospective student should inquire directly from the appropriate director of graduate studies. (For methods of meeting the requirement, see Language Requirements.)

A student working toward the doctoral degree should complete the language requirement for that degree by the end of his first year of residence. If he fails to meet the requirement by the end of his third semester of residence, he should register in the appropriate special reading course or courses until he has satisfied the requirement.

The foreign language requirement must be met before preliminary examinations are taken.

Major and Related Work. The student's program of study necessarily demands substantial concentration on courses in his major department. It may, however, include a minimum of 6 units in a related field approved by his major department. Use of related fields within the major department requires the authorization of the Dean of the Graduate School and the Executive Committee of the Graduate Faculty.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable and not later than two months before the preliminary examination the director of graduate studies in the major department will nominate for the approval of the Dean a supervising committee consisting of five members with one designated as chairman. This committee will include at least three graduate faculty members of the major department and, usually, at least one from outside the department. However, related work and a committee member representing that related work may be chosen from a clearly differentiated division within the department, with the approval of the Dean

and the Executive Committee of the Graduate Faculty. This committee, composed of all five members, will determine a program of study and administer the preliminary examination. However, the final examination, with such changes as are approved by the Dean, will be administered by a minimum of four members, one of whom must represent a field other than the major.

Residence. The minimum registration requirement is 60 units of graduate credit, of which not more than 30 units may be accepted by transfer. Since a full program is 30 units per academic year, the prospective Ph.D. candidate who enters with the A.B. or B.S. degree must plan to spend in residence a minimum of two academic years; if he enters with the A.M. degree, his minimum residence is one academic year. (For the definition of residence, see the section on residence in the chapter on Academic Regulations.) If there are undergraduate deficiencies in his program, he may in addition to the minimum requirements be required to take preliminary undergraduate courses for which he will not receive graduate credit. Even if there are no such undergraduate deficiencies, the student's supervisory committee will determine what requirements, if any, above the minimum the student must meet.

Credit for Summer Work. Credit earned in the summer session will not reduce the minimum required residence (see section on the summer session).

Time Limitations. At the time that the preliminary examination is passed any courses, language certifications, or other credits for advanced standing which are more than six calendar years old will not be accepted toward fulfilling the minimum requirements of the doctoral degree.

The student should normally pass the preliminary examination by the end of the third year of graduate study. If he has not passed it by the end of the third year of full-time registration, he must file with the Dean of the Graduate School a statement, approved by the director of graduate studies in his major department, explaining the delay and setting a date for the examination. Except under unusual circumstances, extension will not be granted beyond the middle of the fourth year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate, with the approval of his committee, may petition the Dean of the Graduate School for an extension of up to one year. If this extension is granted and the dissertation is not submitted and accepted by the new deadline, the student must pass a second preliminary examination to remain a candidate for the degree. In such a case, the time limit for submitting the dissertation will be determined by the Dean of the Graduate School and the candidate's committee.

In cases of particular merit, and with the approval of the Dean of the Graduate School, departments may extend the limits of the total elapsed time within which credit will be allowed for courses, the language examinations, and the preliminary examination. The graduate faculty of the departments will have these limits in mind when a student is considered for admission or readmission to the Ph.D. program, for approval to take the preliminary examination, and for approval to submit the dissertation and take the final examination. In instances of excessive elapsed time, revalidation of credits may be required. The responsibility for requiring such revalidation will normally lie within the department, but the Dean's approval will be necessary.

Preliminary Examination. A student is not accepted as a candidate for the Ph.D. degree until he has passed a preliminary examination. A transfer student who may have passed a preliminary examination elsewhere must nevertheless take the examination at the Duke Graduate School. The examination ordinarily covers both the major field and related work. In the



summer, a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

Privilege of Re-Examination. Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and of the Dean of the Graduate School, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Failure on the second examination will render the student ineligible to continue his program for the Ph.D. degree at Duke University.

Reduction in Registration. Because the student who passes the preliminary examination is eligible for a reduction in required registration, he should assume responsibility for arranging in person with the Graduate School Office the change in registration he desires.

The Dissertation. The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

One month before the dissertation is presented and not later than February 1 (February 2 if February 1 falls on Sunday) preceding the May commencement at which the degree is expected to be conferred, the student must file with the Dean of the Graduate School, on the official form to be obtained from the Graduate School Office, the title of the dissertation. This title must receive the written approval of both the director of graduate studies of the student's major department and the professor who directs the dissertation.

The basic requirements for preparing the dissertation such as type of paper, form, and binding are prescribed in the Guide for the Preparation of Theses and Dissertations which is available in the Graduate School Office.

The dissertation must be completed to the satisfaction of the professor who directs it. Four typewritten copies bound in snap binders secured through the Graduate School Office must be deposited with the Dean of the Graduate School on or before April 1 preceding the May commencement when the degree is to be conferred. The dissertation must be submitted to the Graduate School Office at least seven days before the scheduled date of the student's examination.

All doctoral dissertations are published on microfilm through University



Microfilms, Ann Arbor, Michigan. Authors may also copyright them, if they wish. Abstracts are published in *Dissertation Abstracts International*.

In brief, all copies of the dissertation, the original in clean type, will remain in spring binders until after the final examination. Three extra copies of the abstract, carefully written and not more than 600 words long, are submitted when the dissertation is first presented to the Graduate School Office. A nonreturnable fee of \$25.00 is charged for microfilming. If copyright is desired, an additional fee of \$15.00 is charged. The original and two copies will be bound by the Ruzicka Bindery at a cost of \$5.00 per volume. The student may request that more than three copies be so bound. If more than one snap binder is required per copy of the dissertation, a deposit of \$3.50 will be collected for each additional snap binder.

Final Examination. The final oral examination shall be primarily on the dissertation. Questions may, however, be asked in the candidate's major field. Except in unusual circumstances approved by the Dean a final examination will not be scheduled when school is not in session.

If a student fails his final examination, he may be allowed to take it a second time, but not sooner than six months from the date of his first examination. Permission to take the second examination must be obtained from the professor who directed the dissertation and from the Dean of the Graduate School. Failure to pass the second examination renders the student ineligible to continue work for the Ph.D. degree at Duke University.

Deposit of the Dissertation. After passing the examination, the candidate brings to the Graduate School Office the original and the first two copies of the dissertation, properly signed, as well as other copies he wishes bound. At this time he signs the microfilming agreement and pays the microfilming and copyright fees which are due.

DOCTOR OF EDUCATION

The Ed.D. degree is a professional degree for those who are, or intend to become, professional personnel in the field of education. The student will

choose one of the following as his area of concentration: (a) administration, (b) supervision, (c) counseling, (d) curriculum and instruction, (e) education of emotionally disturbed, (f) higher education, (g) reading, or (h) school psychology.

To be considered as a candidate for the Ed.D. degree, the student must have made passing grades in the first 30 units of course work, and on at least 24 units of this course work he must have made a grade of G or better.

Major and Related Work. The minimum registration requirement is 60 units of graduate credit, of which not more than 18 units may be in research or accepted by transfer. (Transfer credits which are more than six calendar years old at the time that the preliminary examination is passed will not be accepted.) The student's program must include at least 30 units of course work in his area of concentration and 12 units in related areas or a minor (certain areas of concentration permit a minor within the department).

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable, and not later than two months before the preliminary examination, the Director of Graduate Studies will nominate for the approval of the Dean a supervising committee of five graduate faculty members, with one member designated as chairman. One or more members must represent the student's minor field. The committee will determine a program of study and administer the preliminary examination and, with such changes as are approved by the Dean, the final doctoral examination.

Experience. Prior to receiving the Ed.D. degree, the student must have at least two years of experience in professional education.

The program of study must include a minimum of 6 units in a practicum, internship, and/or field experience under the direction of one or more faculty members.

Time Limitations. The student should normally pass the preliminary examination by the end of his sixth year of graduate study at Duke. If he has not passed it by this time, he must file with the Dean of the Graduate School a statement, approved by the Director of Graduate Studies, explaining the delay and setting a date for the examination.

The dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed.

Preliminary Examination. A student is not accepted as a candidate for the Ed.D. degree until he has passed the preliminary examination. The examination covers both the major field and related work, and is taken during or shortly after the term in which the approved program of course work is completed.

Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and the Dean of the Graduate School, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Failure on the second examination will render the student ineligible to continue his program in the Department of Education at Duke University.

Dissertation. The dissertation should be a mature and competent piece of writing which demonstrates the student's ability to collect, arrange, analyze, evaluate, interpret, and report pertinent material in his area of concentration. This may embody the results of applied research in the form of a major project or model (for example: in-service education plans for a school system, computer programs, curriculum guides, instructional materials) or the results of significant and original research.

Procedural regulations governing the Ed.D. dissertation and final examination are identical to those for the Ph.D. degree.



Special and Cooperative Programs

Center for the Study of Aging and Human Development

The primary aims of the center have been to encourage and support fundamental research concerned with the processes and health problems of aging; to train investigators for research in the problems of aging; and to develop a source of scientific knowledge in the field of aging for state and local government as well as for private groups and individuals.

The center conducts a two-year program for predoctoral or postdoctoral fellows who desire to pursue research training in some aspect of the behavioral sciences and psychophysiology in aging and human development. Through faculty seminars and independent work, fellows are enabled to focus on a chosen aspect of the life spectrum. Methodology and acquisition of specialized skills are stressed in addition to involvement in individual research. Under this program, continuation of research training support for a third year is possible. Resources available include the Psychophysiology Laboratory, research programs in behavioral medicine, child psychiatry, and geriatrics, as well as staff and facilities in anatomy, biochemistry, economics, endocrinology, obstetrics and gynecology, physiology, preventive medicine, psychiatry, and sociology, among others. Inquiries should be addressed to the Training Director, Center for the Study of Aging and Human Development, Duke University, Durham, North Carolina 27710.

Canadian Studies Program

The Canadian Studies Program was inaugurated in September, 1973, with the aid of a grant from the Donner Foundation for the purpose of formalizing and expanding Duke's interest in Canada, of extending it into the undergraduate curriculum, and of introducing the study of Canadian culture. Its basic aim is to increase American knowledge and understanding of Canada.

The program awards graduate fellowships for the study of Canada by American residents in the Departments of History, Political Science, Sociology, and Economics; and it grants travel aid for field research in Canada. Teaching assistantships are also available.

The program sponsors lectures by Canadian specialists. It cooperates with the Center for Commonwealth Studies in sponsoring the Commonwealth joint seminar on Canadian topics.

Publications arising from research on Canada may be published in the Commonwealth Studies Series.

Inquiries should be addressed to the Director of Canadian Studies, 237 Social Sciences Building, Duke University, Durham, North Carolina 27706.

Center for Commonwealth Studies

The Center for Commonwealth Studies was established at Duke University in 1955 and has received financial support from the Carnegie Corporation of New York, the Rockefeller Foundation, and the Ford Foundation. Its objectives are:

1. To encourage and stimulate the research interests of individual scholars in Commonwealth affairs, European institutions and their expansion, and development studies.
2. To establish at Duke University a center whose facilities will promote interest in research relating to the Commonwealth, provide the materials for basic research, and encourage research by Commonwealth and American students and faculty.

The center awards fellowships to graduate students from Australia, Canada, and New Zealand who propose to study toward the Ph.D. degree in economics, history, or political science at Duke University. National selection committees in each of the above mentioned countries facilitate the selection of fellows.

Each spring the center sponsors a joint seminar for graduate students in economics, history, and political science. The objective of this seminar is to encourage a broad approach to developments within the Commonwealth. In addition, the center sponsors lectures at the University by distinguished Commonwealth scholars.

Studies resulting from research sponsored by the center are frequently published by the Duke University Press in the Commonwealth Studies Series, now numbering forty-one volumes. Inquiries should be addressed to the Director, Center for Commonwealth Studies, Duke University, Durham, North Carolina 27706.

Program in Comparative Studies on Southern Asia

The Program in Comparative Studies on Southern Asia was established at Duke University in 1961 following a grant from the Ford Foundation to the Center for Commonwealth Studies to enable it to develop a research and training program in that area. In 1963 the University entered into a contract with the United States Office of Education and sponsored a South Asian Language Training and Area Center under the provisions of Title VI of the National Defense Act. The basic purpose of this program is twofold: to facilitate research on the political, historical, economic, and sociocultural development of Commonwealth countries in Southern Asia (India, Pakistan, Ceylon, Malaysia, and Singapore), and to provide for the systematic training of graduate students in anthropology, economics, education, history, political science, religion, and sociology, with special emphasis on the area.

The graduate student, in addition to meeting the requirements of the department in which he is enrolled, is expected to take Hindi-Urdu or an-

other major South Asian language, the cognate courses in other departments, and to undertake field research in the preparation of his dissertation.

The program awards each year a limited number of predoctoral fellowships under the conditions specified above. Awards carrying the same expectations are also made under the NDEA Title VI language fellowships offered by the United States Office of Education.

Facilitation and support of research activities by members of the Duke University faculty and graduate students are important aspects of the program's activities. Research grants for faculty and students are also available from the American Institute of Indian Studies and the United States Office of Education. Research facilities include those materials received as a result of the University's participation in a library acquisitions program under the terms of Public Law 480.

The program has undertaken the publication of three series: hardcover monographs, reprints of articles of note dealing with the Southern Asian region, and a series of occasional papers. It also brings visiting Asian scholars to the campus for lectures and symposia, and co-sponsors forums and research activities with the Carolina Population Center of the University of North Carolina, the Southern Atlantic States Association for South Asian Studies, and the Association of Asian Studies.

Inquiries should be addressed to the Administrative Assistant, Program in Comparative Studies on Southern Asia, Duke University, Durham, North Carolina 27706.

Cooperative Program in Teacher Education

(Program in Secondary Education for the M.A.T. Degree)

Selected graduates of liberal arts colleges who have not completed a teacher preparation program will be admitted to the Cooperative Program in Teacher Education to complete their requirements for a teacher's certificate and to pursue additional training in the proposed teaching field. Full-year internships with salary are arranged with cooperating public and private school systems. Students admitted to this program are required to attend the first summer session before their internship. This program is limited to students preparing to teach biology, English, mathematics, and social studies in junior and senior high schools. For materials describing this program, write to the Graduate School, 127 Allen Building, or to Director, Cooperative Program in Teacher Education, Department of Education, West Duke Building, Durham, North Carolina 27708.

Cooperative Programs with Neighboring Universities

Interchange of Registration. (See Registration, the Reciprocal Agreements with Neighboring Universities.)

Library Exchange. Students of both the University of North Carolina and Duke University are granted certain library privileges in the libraries of each university. Books available in one library may be procured through an inter-library loan service.

Cooperative Program in Russian and East European History. The graduate schools of Duke University and the University of North Carolina offer a cooperative program leading to the A.M. and Ph.D. degrees in several disciplines (economics, history, literature, linguistics, political science, sociology) with a concentration in Russian and East European Studies. Students admitted to one institution are encouraged to enroll in those courses at the other institution that are advantageous to their programs, and to utilize the

libraries and facilities of both universities. The holdings of the two libraries in Russian and East European materials are substantial and complementary. Both libraries have a policy of purchasing all significant published works in Slavic history, economics, government, geography, literature, and linguistics. Other joint activities include a monthly colloquium involving the personnel of the two institutions and distinguished visiting scholars.

Center for Demographic Studies

A Population Studies Program was established at Duke University in 1963 to promote research and training in demography and human ecology. The program was redesignated as the Center for Demographic Studies in 1972 in recognition of its broad multidisciplinary focus and expanded research programs.

Training under the auspices of the center leads to a Ph.D. degree within either the Department of Sociology or the Department of Economics. Although degrees are awarded through either department, the program is designed to provide an integrated cross-disciplinary training in the common specialty area of population studies. The bearing of sociological and economic theory upon the analysis of demographic phenomena is emphasized, and participation in active research projects is afforded center trainees.

In addition to course and research opportunities, which are open to any interested graduate students in the University, a weekly non-credit seminar meets throughout the academic year for presentations by students, staff, and visiting guest lecturers.

Graduate Fellowships for students in the training program are available. Inquiries may be directed to Dr. George C. Myers, Director, Center for Demographic Studies, Box 4732, Duke Station, Duke University, Durham, North Carolina 27706.

Duke Environmental Center

Environmental and ecological programs exist in several departments and schools at Duke University, including botany, engineering, forestry, medicine, and zoology. In order to provide better coordination among these programs and to stimulate further teaching and research in environmental subjects, the Duke Environmental Center was formed in January, 1972.

The purposes of the Duke Environmental Center are to focus attention on pressing environmental problems, to provide orientation and educational opportunities in environmental subjects for both students and faculty, to promote interdisciplinary environmental research, and to serve as a point of contact for University and environmental agencies and the public. The center does not offer degrees, but allows students and faculty to emphasize the environmental aspects of their studies and research by becoming affiliated with the center while remaining in their established departments and professional schools. The center sponsors a visiting speakers program, graduate and faculty seminars, and graduate and undergraduate courses in environmental studies.

A reference room containing books, periodicals, and research papers on environmental subjects is open to students, faculty, and the public in room 210 Old Chemistry Building. Information on environmental programs and courses offered at Duke and other Research Triangle institutions and on internships and opportunities in environmental careers may be obtained by writing or visiting the Environmental Center Office, 210 Old Chemistry Building, Duke University, Durham, North Carolina 27706.

The University Program in Genetics

The University Program in Genetics was established to provide for the coherent development of instruction and research in genetics throughout the University. The faculty of the program consists of scientists holding primary appointments in the various biological science departments who have joined together in developing an interdepartmental graduate curriculum designed to meet the needs of students with a wide variety of educational background and professional objectives. Students in any of the science departments may specialize in genetics under the auspices of the interdisciplinary University Program in Genetics.

For current information consult Dr. S. R. Gross, Nanaline H. Duke Building, Room 151, Duke University, Durham, North Carolina 27710.

Program in the History of Social Sciences

An interdisciplinary program in the history of the social sciences has been established at Duke University under a grant from the National Science Foundation. Training and research is directed toward the origins and development of the social sciences, new critical assessments of current theory, and methodology. Participating students are Ph.D. candidates in the social sciences, who are exposed to sociological, philosophical, and historical analyses of the development of their subjects in an interdisciplinary context.

The nucleus of the program is an interdepartmental seminar, and special courses on such relevant topics as the History of Economic Thought and Economic Policy and the Sociology of the Social Sciences are included in the syllabus. Visiting scholars from other institutions and abroad are invited occasionally to contribute to the program.

Fellowships for graduate students are provided from the National Science Foundation grant and from other University sources. Students may pursue degrees in one of the following departments: anthropology, economics, political science, or sociology. The stipends, renewable annually upon successful completion of the year's work, provide support for two years of course work and one year of dissertation preparation. Some assistance is also given for travel to special library collections and archives.

The Perkins Library at Duke contains exceptionally strong holdings in the history of the social sciences, including books, periodicals, and manuscripts. Another resource (published by the Duke University Press) is the *History of Political Economy*, a journal devoted to the history of economic thought.

Inquiries should be addressed to the Program in the History of the Social Sciences, Duke University, 2101 Campus Drive, Durham, North Carolina 27706.

Hispanic Studies Program

The Graduate School offers an interdepartmental program of Hispanic studies leading to the A.M. and Ph.D. degrees. Students may write their theses and take their degrees in history, economics, political science, sociology, or Hispanic languages and literatures. The purpose of the program is to make possible a desirable combination of courses on the Hispanic world in these related disciplines and to expose a single candidate to more rigorous training. This may be achieved through a judicious use of related fields or by such special arrangements as may become necessary.

The Duke University library holdings have been built up to facilitate

graduate work and research in Hispanic-American cultural history, inter-American relations, economic history, politics, and Spanish-American literature. These collections are being enlarged constantly.

Materials-Fields-Mechanics Research Program

The Graduate School offers an interdisciplinary program in materials research leading to the M.S. and Ph.D. degrees. Students write their theses and take their degrees in one of the engineering departments but have access to the resources of an interdepartmental faculty, comprising the Materials Research Group. The purpose of the program is to encourage and facilitate research on the interactions of materials with various fields (stress, thermal, electromagnetic, fluid, etc.).

Requests for information about specific research areas available may be obtained through the directors of graduate studies in biomedical, civil, electrical, and mechanical engineering.

Medical Scientist Training Program

The Medical Scientist Training Program, conducted under the auspices of the School of Medicine and the Graduate School, is designed for highly qualified students who are strongly motivated toward a career in the medical sciences and academic medicine. It provides an opportunity to integrate graduate education in one of the sciences basic to medicine with the clinical curriculum of the School of Medicine. The program requires six to seven years of study and leads to both the M.D. and Ph.D. degrees. Although the special emphasis of this program is on basic medical science, the trainees, because of their education in clinical medicine, have a remarkable range of career opportunities open to them. Graduates of this program generally follow one of two broad paths. Some directly pursue careers in teaching and research in one of the basic medical sciences, while maintaining strong ties with clinical science as a result of their combined training; others enter residency programs before pursuing investigative and teaching careers in clinical medicine, carrying with them strong academic backgrounds in the basic sciences.

Eligibility. Applicants must meet the admission requirements of both the Medical School, as a candidate for the M.D. degree, and the Graduate School as a candidate for the Ph.D. degree. Most candidates apply for admission to the first year of the program, but applications are accepted from students who are in residence in the Medical School or Graduate School of Duke University. In addition to the minimum requirements for acceptance in the Medical School and the Graduate School, advanced course work in science and mathematics as well as prior research experience will count heavily in the selection of candidates.

Financial Support. Students admitted to the first year of the program are provided with a traineeship award. This consists of a full tuition scholarship during the first, second, and final years of the program, while the trainee is enrolled in the School of Medicine. During the intermediate years, while the trainee is enrolled in the Graduate School, a full tuition scholarship and an annual stipend of \$3,000 plus an allowance of \$500 per dependent will be provided by basic science departments participating in the program. Support will be continued until the trainee has completed both degrees provided his progress remains satisfactory.

The Training Program. This program has been designed to offer trainees great latitude in the selection of course material. Basic requirements are two

academic years composed of the first basic science year and the second clinical science year of the curriculum for medical students at Duke University. Following completion of the second year, the trainee enters the graduate program to complete the requirements for the Ph.D. degree. One more academic year of elective clinical study is necessary to complete the requirements for the M.D. degree. Both degrees are awarded at the completion of this sequence.

Additional information may be obtained by writing Robert E. Fellows, M.D., Ph.D., Associate Director, Medical Scientist Training Program, Box 3709, Duke University Medical Center, Durham, North Carolina 27710.

The Medical Historian Training Program

The Medical Historian Training Program is conducted under the auspices of the School of Medicine and the Graduate School to provide professionally trained medical historians. A minimum of six years of graduate study is required. Upon satisfactory completion of the program, the M.D. and Ph.D. degrees will be awarded. It is anticipated that graduates will undertake a minimum of one year of postgraduate medical training, following which their major effort will be in teaching and scholarly activities in the field of the history of medicine. They also may have minor clinical responsibilities.

Basic requirements are two academic years in the School of Medicine consisting of "core" basic sciences in the first year, ending with the course Introduction to Clinical Medicine, and "core" clinical sciences during the second year, following which the student enters the Department of History in the Graduate School.



Candidates for the Ph.D. degree in history devote approximately two full years to the completion of their required courses, work in seminars, and preparatory study of their preliminary or qualifying examinations. The actual length of time needed to earn the Ph.D. degree depends upon the number of years beyond this two-year period candidates find necessary for research and writing their dissertations. Candidates will pursue studies in the Department of History during the third and fourth academic years of the program. In the fifth and sixth years, the student should have one year in which to pursue medical-historical research and one year of elective courses in the School of Medicine to fulfill the requirements for the M.D. degree.

Application and Admission Procedures. Applicants must meet the requirements for admission to the School of Medicine and the Graduate School in the Department of History. Candidates who have completed two years of medical school will also be considered.

In addition to the minimum requirements established by the School of Medicine and the Graduate School, courses in history and the history and philosophy of science will count heavily in the selection of candidates.

Applicants should complete and submit an application to the Graduate School for admission to the Department of History.

Additional information may be obtained by writing to Gert H. Brieger, M.D., Ph.D., Director, Medical Historian Training Program, Box 2914, Duke University Medical Center, Durham, North Carolina 27710.

Program in Medieval and Renaissance Studies

The Graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. A participating student is based in one of the regular departments and fulfills the Ph.D. degree requirements for that discipline, and in addition he takes a program of electives which will aid his interdisciplinary competence in the medieval or Renaissance areas (or some intellectually valid combination of the two). Such a program includes a choice from the fields of art history, language and literature, history, philosophy, and religion. In other words, the student is enabled to minor in medieval and Renaissance studies.

The Committee on Medieval and Renaissance Studies awards three annual fellowships to outstanding doctoral students. Each fellowship is renewable twice, with renewal based on a review of the student's program by the committee.

The Committee on Medieval and Renaissance Studies sponsors also an undergraduate program, the *Journal of Medieval and Renaissance Studies*, a monograph series in the field, and lectures by distinguished visiting scholars.

Inquiries should be addressed to the Chairman, Duke University Committee on Medieval and Renaissance Studies, Box 4666, Duke Station, Durham, North Carolina 27706.

Predoctoral Training Program in Sciences Related to the the Nervous System

This is a training program to develop scientists with an especially broad understanding of the current status, techniques, and approaches of the several disciplines contributing to our knowledge of the nervous system, behavior, and mental health. Participants will work toward the Ph.D. degree in one of the departments listed below. In lieu of the minor field of study, they will receive expanded learning experiences in the form of a broadly based

curriculum, tutorial courses, and seminar series in the current issues of neurobiology. In view of the diversity of the topic, each curriculum will be structured by a special committee to suit the individual's needs and interests. This program is especially designed to foster the development of individuals who have a broad understanding of the neurosciences, and, in addition, are fully equipped to contribute to the expansion of knowledge through research in their fields of expertise. Participating departments include anatomy, microbiology and immunology, physiology and pharmacology, biochemistry and genetics, pathology, and psychology. Further information may be obtained by writing Frans F. Jobsis, Ph.D., Chairman, Training Committee, P.O. Box 3709, or Walter D. Obrist, Ph.D., Program Director, Duke University Medical Center, Durham, North Carolina 27710.

Oak Ridge Institute of Nuclear Studies

Duke University is one of the sponsoring universities of the Oak Ridge Institute of Nuclear Studies located at Oak Ridge, Tennessee. The graduate research program at Duke has available to it all the facilities of the Oak Ridge National Laboratory and the cooperative supervision of student research by the staff at Oak Ridge. Fellowships in several fields of science are available to qualified applicants.

Graduate Fellowship Program. On application by a university, the Institute awards fellowships to candidates for the master's and doctor's degrees. The student uses the fellowship to conduct thesis research in an Oak Ridge laboratory.

AEC Special Fellowships. These are available in the fields of (1) nuclear science and engineering, (2) health physics, (3) advanced training in health physics, and (4) industrial hygiene.

The application deadlines differ for different fellowships. Further information may be obtained from Lewis E. Anderson, Department of Botany, Duke University, Durham, North Carolina 27706.

Organization for Tropical Studies

Duke University is a member of a consortium created to promote an understanding of tropical environments and their intelligent use by man. To achieve these objectives, the Organization for Tropical Studies (OTS) fosters research and educational programs in the New World tropics.

Fellowships are available for travel and subsistence in field-oriented programs in Central America. The basic course, Tropical Biology: An Ecological Approach, runs for an eight-week period from January-February and July-August. Advanced offerings are periodically scheduled in agriculture, anthropology, botany, earth sciences, forestry, geography, marine biology, meteorology, and zoology.

The course schedules and application deadlines vary from year to year. Consult the respective University departments for current information on OTS activities, or Dr. Donald Stone (Botany) and Dr. Peter Klopfer (Zoology).

Institute of Policy Sciences and Public Affairs

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The course of study consists of a series of joint degree programs leading to the Master of Arts in Public Policy Sciences degree and a doctoral or professional degree.

Such a program is designed to foster in highly trained professionals the perceptual and analytical skills necessary for sound public decision-making. The Institute does not award independent A.M. or Ph.D. degrees. With the exception of those individuals already possessing doctoral or professional degrees, all graduate students in the Institute must pursue a concurrent degree in another department or school at Duke, or at a nearby co-operating institution. Joint degree programs exist or are being developed between the Institute and the Schools of Law, Engineering, Medicine, and Business Administration, and with several graduate departments.

Students usually apply for the joint degree program simultaneously with their applications to other graduate departments or professional schools, or during their first or second year of advanced study. Candidates are expected to complete an equivalent of one full year of work beyond that required by their doctoral or professional degrees.

The joint degree curriculum involves a minimum of ten courses to be specified by the Institute. Academic work includes a four-course research sequence and a summer internship in such specialized policy areas as law and the administration of justice, communications, health, and education. This policy research sequence, in which the student works closely with faculty in a tutorial or a small-group situation, stresses the development of analytical skills applicable to the broad range of policy areas.

Further information concerning specific joint degree programs may be obtained from the Director of Graduate Studies, 109 Old Chemistry, Duke University, Durham, North Carolina 27706.

Social Systems Simulation Program

This is an interdisciplinary program to stimulate the use of model building and computer techniques in the social sciences. Although an outgrowth of the Econometrics Program, it is broadly based in that it involves the participation of faculty from business administration, economics, education, mathematics, political science, psychiatry, psychology, and sociology. It provides resources and facilities to predoctoral students pursuing the Ph.D. degree in a variety of fields. Inquiries should be addressed to the Director, Social Systems Simulation Program, P.O. Box 4774, Duke Station, Durham, North Carolina 27706.

Center for Southern Studies

The Center for Southern Studies engages in interdisciplinary inquiries into both the contemporary and historical South. Concerned both with scholarly research and its practical application in the emerging industrial states of the region, the center has been instrumental in the creation of a multi-state Southern Growth Policies Board to foster regional economic planning. Under the auspices of the Board, Southern business, labor, educational, and political leaders, including nine governors, are engaged in developing modern approaches to problems of basic concern.

The center's Oral History Project focuses upon the development of additional Black sources on the Southern past with a view toward fostering a multi-racial history of the region. The center is also cooperating with the Department of History in the training of graduate students in oral research methodology.

The center offers an interdisciplinary undergraduate course on The Changing South (IDC 199) which explores the geography, economics, politics, and culture of the region. As an adjunct of this course, the staffs of the center and the Perkins Library have created a Center for Southern Studies



Reading Room containing over 300 volumes relating to the historical and contemporary South.

Inquiries relating to the Oral History Program may be directed to Dr. Lawrence Goodwyn, 219 Old Chemistry Building, Duke University, Durham, North Carolina 27706.

Stochastic Systems Program

A comparative program in stochastic systems analysis is sponsored by the Department of Electrical Engineering at Duke and the Department of Statistics of the University of North Carolina at Chapel Hill, in cooperation with the Departments of Mathematics at the two institutions. The program is designed for graduate students interested in applications of stochastic processes and statistical inference. A student interested in this area may enroll in any one of the sponsoring or cooperating departments in a program leading to a master's or a doctor's degree, awarded through that department. Mutual interaction between the departments is provided by complementary course offerings and cooperative student advising. The student may thus arrange a variety of programs within the general stochastic systems area, emphasizing the more theoretical or the more applied aspects at his discretion. In addition to the courses regularly available, special courses will be offered on various topics. A stochastic systems seminar is an integral part of the program. Further information concerning this program may be obtained from either the Director of Graduate Studies, Department of Electrical Engineering, Duke University, Durham, North Carolina 27706 or Dr. C. R. Baker, Department of Statistics, University of North Carolina, Chapel Hill, North Carolina 27514.



3

Resources for Study

The Libraries

The William R. Perkins Library has shelf space for 1,500,000 books, seats for 1,250 readers, and a staff of 200. Since the completion of the renovation of the old building in the spring of 1970, the entire complex provides room for 2,500,000 books and 2,100 readers. Study space includes about 700 carrels, 200 closed and 500 open, of which 475 are in the new building.

On the main floor—at ground level—are the reference and loan departments, bibliography, current periodicals, inter-library loan, and all units of technical processing. Documents, newspapers, microtext collection, and the micro-photography laboratory and other copying facilities are located on the floor below. The administrative offices and graduate reading room are on the second floor, and manuscripts and archives on the third. Twelve small reading and study rooms are provided in the stacks for the departments in the humanities and social sciences which grant the doctorate. Four seminar rooms are also provided in the stacks.

Microphotography and photographic services utilize modern equipment for reproducing printed and manuscript materials and for the reading of materials in the microtext collection. A special room has been set aside for film readers.

In addition to the Perkins Library, there are nine school and departmental libraries with holdings of some 2,438,962 volumes. The Perkins Library has 1,491,739 volumes; the Undergraduate Library, 16,196 volumes; Divinity School, 166,715 volumes; Engineering, 50,844 volumes; Law, 180,-831 volumes; Medical Center, 126,592 volumes; East Campus Library, 210,091 volumes; Biology-Forestry, 120,594 volumes; Chemistry, 29,718 volumes; Mathematics-Physics, 45,642 volumes. Over 100,000 volumes were added in 1972-1973. Approximately 11,000 periodicals and 185 newspapers are received currently.

The extensive resources of the Library for research students may be suggested by the following special collections:

The Trent Collection of Walt Whitman, containing the first and all other important early editions or issues of *Leaves of Grass*; books and articles of Whitman biography and criticism; nearly 300 manuscripts and 400 letters; and pictures, sheet music, and other miscellany.

The George Washington Flowers Collection of books, manuscripts, pamphlets, and newspapers on all phases of Southern history.

The Arents Collection of several hundred volumes relating to the culture and production of tobacco and the manufacture and distribution of tobacco products.

The James A. Thomas Collection of books on Chinese history and culture.

The Guido Mazzoni Library, a collection of approximately 23,000 volumes and 67,000 pamphlets covering the whole range of Italian literature, with special strength in the nineteenth century.

The Gustave Lanson Library of 12,000 books and monographs on French literature.

Latin-American Collections, built around a special Peruvian library of 7,000 books and manuscripts, a Brazilian library of several thousand volumes, and an Ecuadorian library of 2,000 volumes, supplemented by strong collections of the public documents of these and other Latin-American countries.

The Robertson Library of Philippiniana.

The Frank C. Brown Folklore Collection, consisting of about 38,000 manuscript pieces, 1,400 vocal recordings, and 650 musical scores of North Carolina folklore.

The Strisower Library of international law, numbering about 5,000 volumes, with many rare books and periodical files.

The Trent Collection in the History of Medicine (Medical Center Library), containing about 3,000 books and 2,500 manuscripts with special strength in anesthesia, anatomy, English medicine, vaccination, yellow fever, pharmacy, and medical biography.

The Holl Church History Library, dealing primarily with the period of the Reformation.

The Frank Baker Collection of Wesleyana and British Methodism, consisting of 1,500 editions of the works of John and Charles Wesley, 8,000 volumes concerning all phases of the development of British Methodism, 4,000 volumes relating to the religious and social background of British Methodism, and 4,000 manuscript pieces by the Wesleys and their coadjutors and by British Methodists of the last 200 years.

Collections in English and American literature, where emphasis has been placed principally on the eighteenth and nineteenth centuries, with the collections of Swinburne, Tennyson, Rossetti, and Bryant, significant groups of annotated copies and first editions of Coleridge and Byron, the Carroll Wilson collection of Emerson, some 5,000 items of eighteenth-century English poetry and prose, and the Paul Hamilton Hayne library of American literature.

In addition to these and other special collections, the libraries contain excellent files of United States federal and state documents, public documents of many European and Latin American countries, and publications of European academies and learned societies. The newspaper collection, with 15,000 volumes and 30,000 reels of microfilm, has several long eighteenth-century files; strong holdings of nineteenth-century New England papers and of antebellum and Civil War papers from North Carolina, South Carolina, and Virginia; as well as many European and Latin American papers. The manuscript collection of over 4,000,000 items is particularly strong in all phases of the history, politics, and social and economic life of the South Atlantic region,

and includes significant papers in English and American literature. The collection of 124 Latin and 51 Greek manuscripts constitutes one of the outstanding collections of its kind in the United States.

Science Laboratories

Botanical and Zoological Laboratories. Facilities for graduate study in the Departments of Botany and Zoology are located on the West Campus. The Biological Sciences Building, completed in 1962, contains well-equipped modern laboratories for teaching and research in the various fields of botany, forestry, and zoology. Special facilities are available, such as animal rooms, greenhouses, darkrooms, refrigerated and controlled-environment laboratories, scanning and transmission electron microscopes, a Van de Graaff accelerator, X-ray machines, radiation and radioisotope equipment, and other modern research facilities. Extensive facilities for experimentation in the environmental control of plant growth are available in the phytotron adjacent to the botany greenhouses.

The Herbarium, containing over 360,000 specimens, is worldwide in scope and includes notable collections of mosses and lichens. Other unique assets for teaching and research are the Sarah P. Duke Gardens, conveniently located on the West Campus; the four-acre experimental plot and field laboratory developed by the Department of Botany; the Duke Forest, comprising 8,000 acres of woodland adjacent to the West Campus; the field station for the study of animal behavior; and the Duke University Marine Laboratory at Beaufort, North Carolina. Duke University, through the Botany and Zoology Departments, is a member institution of the Organization for Tropical Studies in Costa Rica, a facility providing excellent opportunities for course work and research in tropical flora and fauna.

Scholarships for advanced study during the summer months are available through the Highlands Biological Laboratory, Highlands, N. C.; the



Marine Biological Laboratory, Woods Hole, Massachusetts; and the Duke University Marine Laboratory. Requests for information concerning scholarships at the Highlands Laboratory should be addressed to the Botany Department, those at Woods Hole to the Zoology Department, and those at Beaufort to the Duke University Marine Laboratory.

The Phytotron. The phytotron, officially known as the Duke University unit of the Southeastern Plant Environment Laboratories, is connected to the Biological Sciences Building on West Campus. The facility is administered by the Botany Department. The phytotron is an integrated series of plant-growth rooms, chambers, and greenhouses. Over fifty separately controlled environments provide more than 4,000 square feet of plant-growing space. The controlled units consist of artificially lighted rooms with temperature and humidity controls, reach-in chambers, and six temperature-controlled greenhouses. By using the conditions in various day and night combinations an exceptionally large number of environments can be obtained for testing the growth responses of plants. The phytotron also includes research laboratories and facilities for studying and monitoring the physiological processes of plants.

Research space in the phytotron is available to graduate students and faculty at Duke and to members of other educational and research organizations. For information concerning awards and research space, write to Dr. Henry Hellmers, Director, Department of Botany, Duke University, Durham, North Carolina 27706.

Marine Laboratory. The Duke University Marine Laboratory is located at Beaufort, North Carolina, one and one-half miles from the open ocean. The physical plant includes six well-equipped research buildings, including the recently completed three-story research facility, six classrooms, and four dormitories, two of which are heated and air-conditioned for year round use. The Laboratory provides excellent facilities for summer graduate courses in botany, chemistry, geology, zoology, biochemistry, and physiology and for thesis research throughout the year. Special research and training facilities for field work in marine biology and biological oceanography include two motor vessels and a 118-foot biological research vessel *Eastward* with specialized apparatus for collecting and environmental measurements.

For information concerning research space, write to Dr. John D. Costlow, Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. For information concerning courses refer to Marine Sciences—the University Program in the section on Courses of Instruction.

Animal Behavior Station. Located less than one mile from the campus, the eighty wooded acres of the station provide facilities for the studies of penned, freeranging, and caged animals. These facilities include sound-proofed observation chambers, barns, aviaries, and pens for large mammals and birds, and two waterfowl ponds. An extensive facility for the study of prosimian primates (both simulated natural habitats and cages) was completed in 1968. For information regarding research space or research assistantships in animal behavior, write to Dr. P. H. Klopfer, Department of Zoology, Duke University, Durham, North Carolina 27706.

Primate Facility. A large colony of prosimian primates is housed in the Duke University Primate Facility, adjacent to the Field Station for the Study of Animal Behavior. Research programs in cytogenetics, comparative anatomy, behavior, and reproduction are conducted with the use of the animals as a major resource. For information about graduate study in primate biology and research space write to Dr. Jan Bergeron, Primate Facility.

Physics Laboratories. The Physics Building, containing about 130,000 square feet of floor space, is devoted to research and instruction in the Departments of Physics and Mathematics. An additional 27,000 square feet of space are provided in the Nuclear Physics Building completed in 1968 and

located adjacent to the Physics Building. Graduate students are provided with office space in one of these two buildings.

In addition to the lecture halls and the elementary laboratories, there are instructional laboratories for work in electronics and advanced physics.

About half the building is devoted to special laboratories for research in microwave spectroscopy and atomic, nuclear, high energy, low temperature, and solid state physics. Special equipment includes microwave spectrographs operating up to 500,000 megacycles; one 4 MEV and one high resolution 3 MEV Van de Graaff accelerator, a 30 MEV cyclotron/tandem Van de Graaff accelerator; a helium liquefier, cryostats, magnets, and associated equipment for research down to the millidegree Kelvin temperature range; a Sigma-5 and a DDP-24 computer used for automatic measurement and processing of bubble chamber film in the High Energy Physics Laboratory; and two DDP-224 computers used to collect and process data in the Nuclear Structure Laboratory.

The Physics-Mathematics Library contains an unusually complete selection of books and periodicals. A large, well-equipped instrument shop staffed by ten instrument makers, ten electronics technicians, and a glass blower is in the building.

Chemistry Laboratories. The Chemistry Department occupied a new building in 1969. Named after Dr. Paul M. Gross, a distinguished member of the faculty for many years, the building contains three and one-half floors which provide 146,440 square feet of total area. The usable space is over twice that of the original building, and will allow considerable growth of departmental research programs as well as faculty and student body.

The Chemistry Building is well equipped, providing conditions conducive for research in many areas of current interest. Among instruments available for general use in research problems are Varian T-60 and A-60 nuclear magnetic resonance spectrometers, a Varian C-1024 time averaging computer, a Consolidated Electrodynamics Corporation Type 21-490 mass spectrometer, a Bendix time-of-flight mass spectrometer Model 12, a Perkin-Elmer Model 621 infrared spectrophotometer and Model MPF-3 fluorescence spectrophotometer, and other recording spectrophotometers for infrared and ultra-violet-visible studies. The department also has available a PAR differential pulse polarograph, Digital Equipment Corporation PDP-8/L and PDP-8/F laboratory computers, a Beckman Model L3-40 preparative ultracentrifuge, an Anton Paar precision density meter, a Waters high pressure liquid chromatograph Model 202 and numerous other analytical and preparative gas chromatographs. Among other instruments of primary importance to specific research projects include Varian V-4502-15 and E-9 electron paramagnetic resonance spectrometers, Varian HR-60 and Bruker 100 Mc HFX-10 Nuclear magnetic resonance spectrometers, a DSC-1B differential scanning colorimeter, a Baird-Atomic Fluorespec spectrofluorimeter, Cary Model 14R and Model 15 ultraviolet-visible spectrophotometers, a Durrum-Jasco ORD/UV/CD-5 recording spectropolarimeter and circular dichroism recorder, a Durrum-Gilison stopped flow spectrophotometer, polarographs, a flame photometer, and optical equipment for photochemical and kinetic studies. Equipment for X-ray crystallographic investigations includes a Rigaku-Denki low-angle X-ray diffractometer, a Kratky U-Bar camera, a General Electric XRD-5 diffractometer, a Picker automated full-circle X-ray diffractometer, an Enraf-Nonius automatic diffractometer, Debye-Scherrer powder cameras, and single Weissenberg and precession cameras.

The department has a machine shop, an electronics shop, and a glass-blowing shop. The facilities of the Duke University Marine Laboratory on the coast at Beaufort, North Carolina, are available for specimen collecting and processing in studies of organic chemicals of marine origin. In addition, two other major instruments located in the Research Triangle Park are available for use by the Chemistry Department. These are the A.E.I., Ltd., MS-



902 high-resolution double-focusing mass spectrometer, and the IBM System 370 Model 165 computer, the latter linked by cable to the Duke University Computation Center.

Nanaline H. Duke Building. The Nanaline H. Duke Medical Sciences Building offers a superb environment for the creative research and graduate education of members of the faculty and students in the Departments of Biochemistry and Genetics and Physiology and Pharmacology. The building provides more than 140,000 square feet of laboratory space arranged in four towers around a central service core. Individual laboratories were uniquely designed to meet the special needs of research programs dealing with living organisms. Controlled environment rooms, darkrooms, electronics shops, a library, conference and reading rooms, and a materials-purchasing facility are provided. A vivarium for the temporary care and treatment of experimental animals is available.

Psychology Laboratories. The Psychology Department occupies about 53,000 square feet of air-conditioned space on the main campus which houses its main laboratories, seminar rooms, classrooms, and special facilities. In addition to general purpose laboratories, there are a number of special facilities. For the study of animal behavior there are video-tape-recording facilities, a breeding colony of ring doves and pigeons, and an extensive collection of prosimians, and operant conditioning laboratories. There are also soundproofed and electrically shielded rooms for use with human and animal subjects. Specially equipped rooms are available for computer-controlled experiments in human perception and memory. A number of electrophysiological recording rooms are available, as well as a histological laboratory and surgery. There are photographic darkrooms in the building. The social psychology unit (used jointly with the Department of Sociology) contains observation, communication, and video-tape-recording facilities for the study of social interaction. There is an extensive suite of interview and observation rooms for the study of human personality and clinical processes. The department has a fully equipped experimental trailer for studying the behavior of children on location. Both laboratory computers and remote access to the TUCC IBM 370 Model 165 are available in the building. The department is well supplied with technical help in the form of machine, wood, and electronics shops staffed by three full-time technicians. Other facilities for research and teaching are available in the laboratories and clinics of the adjacent Duke Medical Center.

A number of clinical installations for adults and children, devoted to an extensive range of clinical and guidance problems, cooperate with the department in providing facilities for research and training. In addition, the department operates an experimental school for first- and second-grade and preschool children. The department cooperates with the Department of

Zoology in the operation of an eighty-acre field station and primate facility in the nearby Duke Forest for the study of animal behavior in natural settings (see Animal Behavior Station).

Computation Center. The Duke University Computation Center provides the University faculty and students with a facility for research and instruction.

The center is presently equipped with an IBM System 370 Model 135(240K bytes, one 2314 disk facility, three tape drives, two card readers, two printers, and a Calcomp plotter) which is connected by high-speed telephone lines to an IBM System 370 Model 165 (three million bytes of memory, two 3330 and one 2314 disk facility, five tapes, card reader, and printer) located at the Triangle Universities Computation Center (TUCC) which is in the Research Triangle Park. In addition, there are three medium-speed terminals (card reader and printer) located in the Engineering Building, the Sociology-Psychology Building, and the Biological Sciences Building, and several low-speed keyboard terminals.

The Triangle Universities Computation Center is a nonprofit corporation formed jointly by Duke University, North Carolina State University at Raleigh, and the University of North Carolina at Chapel Hill. The purpose of the TUCC is to provide computing capabilities equal in quality to the finest available.

Faculty members at Duke may use the facilities of the Computation Center by filling out an application for computer services. All users of the Computation Center facilities are urged to obtain funds to pay for computer services. However, any user unable to obtain grant funding may ask for financial support from his department when he applies for the services.

More specific information regarding Duke computing facilities may be obtained from the Director of the Computation Center.

Engineering Research Laboratories. The laboratories of the four departments which comprise the School of Engineering contain a wide range of basic equipment that finds general application in the several fields of specialization. In addition, each laboratory contains selected items of highly



sophisticated equipment used to support advanced research in areas of particular emphasis. The exceptionally fine facilities available for instruction and research are suggested by the following brief listing of selected items to be found in the four departments:

Biomedical Engineering. Holography and ultrasound apparatus; high energy CW helium-neon gas laser, and interferometrically stable table; cellular electrophysiology and neurophysiology instrumentation; stereomicroscope, micromanipulators, stimulators, isolation units, and microelectrode puller; facilities for studying biomedical materials and surface interactions; polarizing microscope, internal reflectance infrared spectrophotometer, and dialyzers; cardiorespiratory measurements; respirator, pressure transducers, and DEC PDP-12 digital computer.

Civil Engineering. Well-equipped research laboratories are available for work in environmental engineering, soil mechanics and geotechnical engineering, solid mechanics and materials engineering, structural mechanics and structural engineering, fluid mechanics, water resources and ocean engineering, and urban systems and transportation engineering. Available research facilities include: two independent closed-loop electro-hydraulic dynamic loading systems (MTS) capable of applying pulses of any shape and controlled in force or displacement modes, frequency range up to 100 cps., load capacity 6,000 and 100,000 lbs. (the 6,000 lbs. actuator can develop a constant crosshead speed up to 50,000 in./min.); equipment for manufacture and testing of fiber-reinforced polymer composites; environmental chamber for testing in the temperature range of -320° to 500°F., ultra-high-pressure triaxial shear apparatus for confining pressures up to 100,000 psi.; high-speed camera for studying explosions and similar phenomena; particle tracking X-ray equipment for soil deformation studies; rock-testing facilities; model-testing equipment for anchored walls, penetrometer studies, and deep pile foundations; large-aperture research polariscope; and a reflective photoelastic polariscope; sustained-loading facility for long duration in studies of prestressed concrete; and a PDP-8 Digital computer with an 8K core memory size, teletype console, paper tape and magnetic tape I/O capabilities, and teletype terminals which are also connected to the IBM 370/165 computer in the Triangle Universities Computation Center.

Electrical Engineering. High-resolution (7\AA) electron microscope with heating and tilting stage; stereo-optical microscopes; ion-pumped bakeable ultra-high vacuum unit; helium dewars and cryostats; 4 inch and 9.5 inch electromagnets and 2 inch bore superconducting magnet; electron paramagnetic and nuclear magnetic resonance spectrometers; X-ray diffractometer with monochromator attachment; x-band microwave instrumentation; cryomagnetic facility for susceptibility measurements; analog and digital computer facilities including DEC Linc 8, PDP-8/I, and PDP-11/45 computers.

Mechanical Engineering. Digital data acquisition system with high speed scanner and magnetic tape; FM-AM instrumentation recorder; 4 square foot subsonic wind tunnel with six-component balance; hot-wire anemometer system; storage and dual-beam oscilloscopes; X-Y and strip chart recorders; temperature, pressure, strain, force, and acceleration transducers; electrodynamic shaker table; sound room; spectrum analyzers; analog computer facility; experimental pneumatic-tube transportation system (1800 ft. x 1 ft. diameter); fuel research engine; materials laboratories with stereo-zoom research metallograph, thermal analyzer, Instron testing machine, high-vacuum system, 10 kw RF generator, heat-treating and arc-melting furnaces, recorders and darkroom.

Also available to graduate students in all four departments of the School of Engineering are the Central Service Shop facilities of the School, as well as those located elsewhere on the campus.



The School of Engineering houses an IBM Model 2780 medium-speed cardreader punch and printer which communicates directly with the IBM System 370 Model 165 computer located in the Triangle University Computation Center in the adjacent Research Triangle Park.

Forestry Sciences Laboratory. The U. S. Forestry Sciences Laboratory of the Southeastern Forest Experiment Station is located in the Research Triangle Park near Durham. This research organization provides outstanding opportunities to complement the research conducted by students in the Department of Forestry. Specialized research projects in forest entomology, pathology, physiology, and soils are currently underway at the laboratory. The staff of the laboratory is available for consultation and participation in seminars. Arrangements may be made for students to conduct certain aspects of their research at the laboratory.

Duke Forest. The Duke Forest serves as an outstanding field laboratory for the students and faculty of Duke University. This forest consists of about 8,000 acres on which grow various types of forests characteristic of the southeastern Piedmont region. Shortleaf pine, loblolly pine, and southern hardwoods represent the main timber types.

Much of the Duke Forest is adjacent to the campus and easily accessible to those who are working in the field providing students and faculty with excellent opportunities to conduct studies in various fields of forestry such as ecology, entomology, land management, meteorology, pathology, physiology, and soils.



4

Student Life

Living Accommodations

Residence Hall Accommodations. The Graduate Center, located near the Duke Medical Center, houses 149 male graduate and professional school students, 56 women graduate and professional school students, and 119 undergraduate women. All assignments are made on a first-apply, first-assigned basis.

The graduate women's section is located in the center and south wings of the second floor, whereas the undergraduate women reside on the third floor. Women's sections are physically separated from the men's residential area. Resident counselors serve both men and women occupants, with a house committee representing student residents.

The limited number of single rooms in the men's section are usually reserved by previous occupants for the following academic year. Other rooms are equipped for two persons. Each double room has the following furnishings for each student: bed with innerspring mattress, chest with mirror, desk with chair, and book shelves. An additional occasional chair is placed in each double room.

Town House Apartments. Duke University operates Town House Apartments primarily for graduate and professional school students. Families and other groups are housed in individual apartments if the interests of the University are served. The setting of these apartments provides single graduate students a comfortable, home-like atmosphere free of all aspects of living inherent to residence halls. Each air-conditioned, two-bedroom apartment is furnished for use by three students.

Central Campus Apartments. Duke University is building a 500-unit housing facility which will be known as Central Campus Apartments. Planned for completion in 1974, the complex will provide housing for married graduate and professional school students, single undergraduate and graduate students, and single and married students in allied health programs.

For single students, efficiencies, one-bedroom, and two-bedroom apartments will be fully furnished. The apartments for married students will include a few furnished efficiencies, and a number of one-, two-, and three-bedroom units in which the kitchen, living room, and first bedroom will be basically furnished. These apartments will be furnished in such a way as to provide economy and convenience to eligible married students, while allowing for individuality.

The monthly rental rates for each type of apartment will be lower than those offered on the current housing market. For further information on these apartments, students should write the Manager of Apartments and Property.

Until the Central Campus Apartments are ready for occupancy, the University has no housing for married graduate and professional school students. However, the Department of Housing Management is prepared to assist these students in locating suitable housing in Durham.

Application Procedures. Each student accepted into a graduate or professional school of the University will be provided with a form on which he may indicate housing needs. This form will be sent to the Department of Housing Management, which will provide more detailed information about the various rates and rental agreements.

Off-Campus Housing. The Department of Housing Management maintains lists of rental apartments, rooms, and houses provided by Durham property owners or real estate agents who will agree not to discriminate in the rental property because of race, creed, or nationality of a prospective tenant. These lists are available in the office only. The Manager of Apartments and Property and his staff will assist any member of the Duke community in seeking suitable off-campus housing; however, off-campus rental properties are not inspected or approved, nor does the University or its agents negotiate with owners for students, faculty, or staff.

For the cost of housing, see the section on Financial Information.

If you desire additional information, please write to: Manager of Apartments and Property, Department of Housing Management, Duke University, Durham, North Carolina 27706.

Food Services. Food service on the East Campus is cafeteria style. The dining facilities on the West Campus include one straight-line cafeteria with multiple-choice menus, a free-flow service area which includes cafeteria counters as well as a grill, and a table-service dining room, the Oak Room, where full meals and *a la carte* items are served. The Cambridge Inn, a self-service snack bar also located in the West Campus Union, is open from 9:00 a.m. until 12:30 a.m. each day except Saturday. All types of snack and sandwich items are available there. The Graduate Center has a cafeteria open at meal hours, and a coffee lounge which is open until 11:00 p.m. Because of the large number of those served in the dining halls, it is not possible to arrange special diets for individual students.

The cost of meals approximates \$3.00 to \$3.75 per day, depending upon the needs and tastes of the individual.

Services Available

Medical Care. The aim of the University Health Service is to provide medical care and health advice necessary to help the student as a member of the University community. The main components of the Health Service include the University Health Services Clinic located in the Pickens Building on

West Campus and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the Insurance Plan.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the Clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultations or medical treatment to be paid for by the student or covered by the Insurance Plan. Facilities of the University Health Services Clinic are available during both regular and summer sessions to all currently enrolled full-time students. To secure the benefits of these services a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until the student has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students in residence. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined in the Infirmary. Hospitalization in Duke Hospital or other hospitals must be covered through private insurance policies or the Duke Student Accident and Sickness Insurance Policy. Financial responsibility for expenses incurred in the Emergency Room rests with the student.

The Student Mental Health Service, which is located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Students may have up to four appointments with the Student Mental Health Service staff at no charge. Further interviews can be arranged, either with members of the Student Mental Health Service staff or with a variety of other local resources at a fee commensurate with the student's ability to pay.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. The rate for 1973-1974 is \$32.90 per student. For additional fees a student may obtain coverage for a spouse or spouse and child. Participation in this program is on a waiver basis. The University expects all students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may waive the Duke Plan by signing a statement to this effect. Each full-time student in residence must purchase this student health insurance or sign a waiver before his registration is complete. The Student Accident and Sickness Insurance Policy provides protection 24 hours per day during the full twelve-month term of the policy for each student

insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. The term of the policy is from August 31. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage. Information concerning this policy may be obtained from the Dean of the Graduate School.

The Duke University Counseling Center. Through the Counseling Center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. A continuing program of research in the areas of counseling and testing is also carried on by the staff of the center.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business and industry, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with graduate students about their future professional plans. Graduate students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations should be accumulated while a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year through the Office of Placement Services for those students who have registered.





Student Affairs

Cocurricular and Recreational Activities. Graduate students new to Duke University are welcome to use such recreational facilities as swimming pools, tennis courts, golf course, and to affiliate with choral, dance, drama, music, and religious groups. They may become junior members of the American Association of University Professors and may affiliate with Phi Beta Kappa and social fraternities. Graduate women and wives of graduate students may join the very active Graduate Women's Club.

A full program of cocurricular and recreational activities is presented by the Associated Students of Duke University; Cultural Affairs Office; Duke University Christian Council; Duke University Union; Student Activities Office; Y.M.C.A.; Y.W.C.A. and recreational clubs. Most programs are open to the entire University community. Inquiries should be directed to the ASDU Office; Chaplain's Office, Duke Chapel; the Office of Cultural Affairs, 107 Page Building; the Duke University Union, 207 Flowers Building; or the Student Activities Office 204 Flowers Building.

The Information Center, Page Box Office, publications offices, art gallery, meeting rooms, lounges, and recreational facilities are located in the Flowers and Union Buildings.

Full information regarding the scheduling of major events and programs for the entire year will be found in the Duke University *Annual Calendar*; detailed and updated information in the *Weekly Calendar*, available on each Fri-

day; and the Duke Chronicle, available each Monday through Friday. Copies may be obtained at the Information Desk or the Calendar Office, Room 107, Page Building.

Graduate Student Association. The Graduate Student Association provides a formal means of communication between the graduate student body and the faculty and administration. Membership in the association is open to all registered graduate students. This student-organized association meets monthly, with representatives present from the graduate enrollment of each department. The association is governed by a steering committee elected annually from the membership. In addition to other functions, the association provides graduate student representation on many campus committees such as those concerning the library, housing, and governance.

Research and Publications

The several departments of the University are devoted to research as well as to instruction. Since a prime purpose of the University is the promotion and diffusion of knowledge, attention in the Graduate School is focused on research and publication.

In an effort to further this purpose, the Provost annually appoints a University Research Council which receives applications from members of the various faculties for subsidies in support of research. Vigorous and forward-looking policies of this Council have initiated and encouraged the completion of many substantial and important research projects.

The Duke University Press is a significant agency in the diffusion of completed research. Created in 1925 as a successor to the Trinity College Press, the Duke University Press continued the publication of the *South Atlantic Quarterly*, published at Trinity College since 1902, and in 1926 it revived the *Hispanic-American Historical Review*, which had been founded and published from 1918 to 1922 by a group of scholars interested in Hispanic America. In 1929 *American Literature* was begun with the cooperation of the American Literature Group of the Modern Language Association. This journal was followed in 1931 by *Ecological Monographs*, and in 1932 by *Character and Personality* (since 1945 entitled the *Journal of Personality*). In 1935 the press began the publication of the *Duke Mathematical Journal*. Since 1948 it has published *Ecology*, the official journal of the Ecological Society of America. In 1965 it began annual publication of *American Literary Scholarship*, in 1969 the *History of Political Economy*, and in 1971 *The Journal of Medieval and Renaissance Studies*.

Since its organization the press has published over five hundred volumes. Included among these are five series: the Duke Historical Publications, the Duke Studies in Religion, the publications of the Lilly Endowment Research Program in Christianity and Politics, those of the Program in Comparative Studies on Southern Asia, and, largest of all with forty-one volumes to date, the publications of the Duke University Center for Commonwealth Studies. In the broadest sense, the policy of the press is to make available to the public any scholarly work that merits publication, though special attention is given to works in fields of knowledge cultivated by the University.

Visiting Scholars

The libraries and other facilities of Duke University are, to the extent practicable, made available to faculty members of other colleges and uni-

versities who wish to spend a period of time on the campus in pursuit of their scholarly interests. A special identification card is furnished a visiting scholar by the Graduate School Office. No fees are charged such visitors unless they wish to participate in activities for which a special fee is assessed. Assistance in locating residence may be obtained from the Department of Housing Management. Inquiries pertaining to visiting scholars should be directed to the individual department chairman or to the Dean of the Graduate School.





5

Admission

Students Requiring Admission

Admission is required of (1) all students who intend to pursue study toward a degree offered by the Graduate School, (2) all other students who desire credit for whatever purpose for graduate courses—except students who register as Special Students in the summer session. Students who have discontinued a program of study after earning a master's degree here must by letter request permission of the Dean to undertake a doctoral program. All applicants will be considered without regard to race, color, religion, sex, or national origin.

Prerequisites

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. The student's undergraduate program should be well rounded and of such quality as to give positive evidence of capacity for graduate study. Usually the student should have majored in the area of intended graduate study. Many departments (see Courses of Instruction) list specific prerequisites. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language tests in French, German, Russian, and Spanish are offered to undergraduate and graduate students at many centers on nationally uniform dates (see Language Requirements).

Procedures

A student seeking admission to the Graduate School should obtain an application blank from the Dean of the Graduate School. This should be filled out completely and returned promptly. Each application must be accompa-

nied by a non-refundable fee of \$15.00 in check or money order payable to Duke University. In addition the student should provide the following supporting documents: (1) two copies of the official transcript from each college, university, or seminary attended sent to the Dean directly by the institution; (2) as soon as possible, two supplementary transcripts showing completion of work which was in progress when the earlier transcript was made; (3) three letters of recommendation, written on the forms provided, by persons best qualified to judge the applicant as a prospective graduate student, and mailed directly to the Dean; (4) scores on the Graduate Record Examination Aptitude Tests for all departments except education; and (5) scores on the Graduate Record Examination Advanced Test for biochemistry, botany, chemistry, English, mathematics, microbiology, pathology, physics, physiology, psychology, Romance languages, sociology, and zoology.

Applicants to the Graduate School of Business Administration and the Department of Health Administration are required to take the Admission Test for Graduate Study in Business, administered by the Educational Testing Service.

Students applying for financial aid in all departments should take the Graduate Record Examination no later than the October testing in order to meet the February 1 deadline. Information on times and places of the Graduate Record Examinations can be provided at the applicant's college or by the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704.

Additional Procedures for Foreign Students. Fully qualified students from outside the United States are welcome to take courses in the Graduate School and, in many instances, to study toward a degree. In applying for admission the foreign student must, in addition to the information required of all students, submit with the application material (1) if the student's native language is not English, certification of English proficiency demonstrated by scores from the Test of English as a Foreign Language (TOEFL), administered through The Educational Testing Service in Princeton, New Jersey, or, if the student is in the United States, a statement of his English proficiency written by a professor of English at the student's university; (2) a statement showing financial arrangements for the proposed term at Duke (estimated costs per academic year are \$4,400); and (3) a statement by a qualified physician describing any emotional or physical illness the applicant has had during the previous five years. A foreign student must meet all these requirements before the Graduate School will make any offer of admission.

All foreign students whose native language is not English will be examined during their first registration period for competence in the use of oral and written English. Until competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack necessary competence will be required to enroll in the non-credit course called English for Foreign Students and to reduce their course or research program by 3 units. Tuition charge for this course will be \$43.00 per unit. A student who does not successfully complete this course during the first year of residency will not be permitted to continue his graduate work at Duke University. Passing this examination or the course, if it is required, will not meet degree requirements for a foreign language. (See Language Requirements for Foreign Students.)

Notification of Status. When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is not complete until the acceptance form has been returned.

Applicants who are admitted will be offered full admission, provisional admission, or nondegree admission. Provisional admission for a trial period of one semester or a minimum of 12 hours of course work is offered to students who appear to warrant admission but do not fully comply with admission requirements. Nondegree admission is offered to students who (1) have no intention of taking an advanced degree at Duke University but wish to take courses, or (2) do not fully meet admission requirements but wish to further their academic interests. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission; graduate credit earned under non-degree status may not be applied toward an advanced degree at Duke University. (See ruling on page 4.)

Deadlines for Application. It is the applicant's responsibility to make certain that the Graduate School Office has received all required material before the specified deadlines. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted at least two weeks before the closing dates listed below:

Fall semester, admission and award	February 1
Fall semester, admission only	July 15
Spring semester, admission only	December 1
Summer session, 1975* first term	April 15
Summer session, 1975* second term	May 15
Summer session, 1975* third term	June 15

*Students seeking admission to the Graduate School for study in the summer session should make application to the Dean of the Graduate School as well as to the Director of the Summer Session.

Anyone whose folder is not complete before that date will face the possibility that departmental enrollment will have been filled. While the Graduate School Office will process all applications, it can not guarantee full consideration of a folder for each department after April 15.





6

Financial Information

Tuition and Fees*

Tuition for all students for a full semester program amounts to \$1,290.00 (15 units at \$86.00 per unit). Part-time tuition is calculated at the same rate of \$86.00 per unit. Tuition charges are due and payable, unless otherwise specified, at the time of registration for that semester and are subject to change without notice. Registration is not considered complete and students may not be admitted to classes until arrangements have been made with the Bursar of the University for settlement of tuition and fees. A late registration fee of \$10.00 is charged any student not completing registration during the registration periods. The *in absentia* fee is due on the date of registration and is subject to the late registration fee if not paid by that date. The fee is \$86.00 for 1 unit per semester.

Students passing the preliminary examination may obtain a reduction in their registration and tuition fee at any time during the five-week period beginning on registration day. No other refund in fee may be obtained. A reduction in registration may be made due to changes in departmental service requirements of assistants provided it is made during the first fourteen days after registration and is approved by the Dean. Any fee reduction for this reason is credited to future registration fees. In the event of death or involuntary withdrawal to enter the armed services, refunds will be made on a pro rata basis. In all other cases of withdrawal, students or their parents may elect to have tuition, and room and board charges refunded or carried forward as a credit for later study, according to the following schedule:

1. Withdrawal before the beginning of classes: full refund.
2. Withdrawal during the first or second week of classes: 80 percent.
3. Withdrawal during the third, fourth, and fifth week of classes: 60 percent.

*The figures contained in this section are projected and are subject to change prior to the beginning of the fall, 1974, semester.

4. Withdrawal during the sixth week: 20 percent.
5. No refunds after the sixth week.
6. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

Fees incurred in connection with thesis or dissertation submission are as follows:

*Binding fee, three copies of thesis or dissertation, other copies optional \$5.00 per copy	\$15.00
Microfilming fee, doctoral degree only, upon final submission	\$25.00
Copyright fee (optional)	\$15.00

An athletic fee for the year of \$25.00 is optional and payable in the fall semester. The Treasurer of the University has sole responsibility for collection of fees and for arranging for the proration of fees.

Special Tuition Rates for Teachers and Others. The Graduate School recognizes a special obligation to encourage the following types of students in their professional and personal advancement: (1) members of the faculties and administrations of the neighboring public schools and colleges, currently engaged in full-time school work while taking courses in the Graduate School, (2) ministers of neighboring churches, (3) spouses of Duke faculty members, (4) full-time employees of Duke University who are paid on a bi-weekly or monthly basis throughout the year and have been employed for one year. The reduced tuition rates specified below do not apply to teachers and ministers while on leave of absence, nor to holders of fellowships, scholarships, or graduate and research assistantships, nor to part-time instructors. Persons working toward a degree cannot hold a faculty rank above that of instructor.

Persons eligible for the reduced tuition rate must meet the admission standards required of all graduate students and must be admitted to the Graduate School. They may enroll for one or two courses per semester (in no case totaling more than 7 units) upon payment of a fee of \$5.00 for registration for each semester and tuition of \$43.00 per unit of credit or an audit fee of \$40.00 per course. Residence requirements cannot be fulfilled at the reduced rate. Students enrolled in doctoral (post-master's level) programs are not eligible for the reduced rate.

Fees for Undergraduate Courses. Graduate students registering for undergraduate courses will be assessed 3 units for a non-laboratory course and 4 units for a laboratory course.

Audit Fee. In a semester in which a student registers and pays fees for 9 units or more, he may audit one course without charge. Should he be permitted to audit a second course or should he be registered for less than 9 units, the audit fee is \$40.00 per course.

Vehicle Fee. Each student possessing or maintaining a motor vehicle at Duke University shall register it at the beginning of the academic year in the Security Office at 2010 Campus Drive. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, he must register it within five (5) calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of \$10.00 for each motor vehicle or \$5.00 for each two-wheeled motor vehicle. Resident students first registering after March 1 are required to pay \$5.00 for any type of motor vehicle.

*If more than one snap binder is required per copy of the dissertation, a deposit of \$3.50 will be collected for each additional snap binder.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least \$10,000 per person and a \$20,000 per accident for personal injuries, and \$5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

If a motor vehicle or a two-wheeled vehicle is removed from the campus permanently and the decal is returned to the Traffic Office prior to March 1, there will be a refund of \$5.00 for a motor vehicle and \$2.50 for a two-wheeled vehicle.

Transcript Fee. A student who wishes to obtain copies of his transcript should direct requests to the Registrar's Office. A minimum fee of two dollars, payable in advance, is charged for a single copy. A charge of fifty cents will be made for each additional copy of the same order.

Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

Expenses*

Housing Fee. The charge for each person in a double room for the academic year is \$393.00 in the Graduate Center. The limited number of single rooms are reserved for returning students.

The fee for Town House Apartments is \$710.00 each for the academic year on the basis of three students to an apartment. Utilities charges are included in these fees.

Housing fees are subject to change prior to the 1974-1975 academic year. A \$50.00 deposit is required on all reservations.

No refund on housing fees is made to students who withdraw after the date of registration, except for those who involuntarily withdraw to enter the armed services. Such refunds will be made in accordance with the University's established schedules.

For further information on housing facilities, see Living Accommodations in the chapter on Student Life.

Food. Food service, on both the East Campus and the West Campus, is described under Living Accommodations. The cost of meals approximates \$750.00 per year, depending upon the needs and tastes of the individual.

Summary. The following table represents an estimate of a graduate student's basic expenses for one academic year for a full program of work. These figures do not include allowances for recreation, travel, clothing, and other miscellaneous items which vary according to personal needs and tastes.

Tuition	\$2,580.00
Room Rent (Graduate Center)	393.00
Board	750.00
Laundry	85.00
Books	200.00

Fellowships and Scholarships

James B. Duke Fellowships. The James B. Duke One Hundredth Anniversary Fund provides fellowships for students who wish to pursue a program

*The figures contained in this section are projected and are subject to change prior to the beginning of the fall, 1974, semester.

leading to the Ph.D. degree in the Graduate School at Duke University. Its purpose is to aid in attracting and developing outstanding scholars at Duke. Selection is made by a faculty committee upon nomination by the student's department. These fellowships provide for payment of tuition for full registration plus an income stipend of \$290 per month for the first two calendar years and \$300 per month for the academic year during the third and final year. The award requires no service and is renewable each year upon satisfactory progress. The total value of a James B. Duke Fellowship over the full three years of tenure is approximately \$15,000. There are forty-four James B. Duke Fellows currently enrolled.

Endowed Fellowships. Other special endowments in addition to the James B. Duke Fund provide fellowships for graduate study. The Angier B. Duke Fellowship provides for one student support of \$4,500 for the academic year. There are six Gurney Harris Kearns Fellowships in Religion ranging in value up to \$3,800. Selection for these fellowships is made through faculty committees.

Graduate Fellowships. Graduate Fellowships funded by Duke University are available to students in the departments of the Graduate School for study during the academic year. Stipends range from \$2,400 for the academic year to \$5,150 for a full calendar year. In 1973-1974, there were 107 students holding these fellowships.

Federal Fellowships.* Duke University participates in the following program:

National Defense Education Act, Title VI Fellowships. The purpose of this program is to encourage persons to undertake advanced training in modern foreign languages and in related area studies not commonly taught in the United States. The purpose of this training is to develop nationwide competence in these languages and the areas in which they are spoken. The world area in which National Defense Foreign Language (NDFL) Fellowships are offered at Duke University is Southern Asia. In addition to pursuing the normal work toward their degrees, during their tenure fellows must engage in intensive study in a language of the world area. The fellowships carry academic-year stipends of \$2,000, \$2,200, or \$2,400, depending on the stage of graduate study, plus tuition and allowances of \$500 for each eligible dependent (with a maximum number of four). In 1973-1974, six students at Duke University held NDFL Fellowships. Interested persons should contact the International Studies Center.

Other federal programs support fellowships, traineeships, and research assistantships through departmental auspices. Over 400 students were supported through these programs during 1973-1974.

Canadian Studies Fellowships. These fellowships are financed by the Donner Foundation for American citizens or permanent residents in the United States who take graduate courses or do research in Canada. The awards are for one year, and the stipends will vary from year to year. The normal award for a nine-month academic year is \$300 per month plus tuition fees at the rate for students who have passed the preliminary examination. Applications may be obtained from the Director of Canadian Studies, 237 Social Sciences Building, Duke University, Durham, North Carolina 27706.

Fellowships in Medieval and Renaissance Studies. Three fellowships are awarded annually by the Duke University Committee on Medieval and Renaissance Studies. Fellows are chosen from among students engaged in Ph.D. programs, and they receive full tuition plus a monthly stipend of \$244.00 for nine months. They may request two renewals of their appointment.

*United States citizenship is generally a requirement for eligibility.



Special Fellowships. The following special fellowships are available to qualified Duke students from sources outside the University:

Shell Fellowships in African Studies. These are available to qualified students in social sciences who are preparing for careers in the State Department, including the foreign services of the United States, the United Nations, or other international agencies, or in research and teaching in international affairs in academic institutions within the United States. They must be citizens of the United States or are, at present, residing permanently in the United States and intending to become citizens. The fellowships are intended to cover the expenses of field research in the preparation of doctoral dissertations. The stipend for each fellowship is \$4,000 plus a reasonable amount for transportation expenses. Inquiries should be made to the Administrative Assistant, Center for International Studies, Duke University.

Cokesbury Graduate Awards in College Teaching. These awards are sponsored by the Board of Education of the Methodist Church. They are designed to assist graduate students who are committed to a Christian philosophy of higher education and who intend to teach in college. The applicant must have been a member of the Methodist Church for at least three years, and must have been accepted for or currently be pursuing a program of graduate studies at one of the Methodist-related universities, including Duke University, approved for this program. Awards for one year vary in amount from \$500 to \$2,500. Applications must be completed before February 1. Further information and application forms may be obtained from the Dean of the Graduate School.

Exchange Fellowships with the Free University of Berlin. These fellowships are available through an exchange arrangement with the Free University of Berlin which will provide fellowships for two graduate students to work during the regular academic year in Berlin. Departments will submit nominations to the Dean of the Graduate School before February 1.

Departmental Fellowships. Various departments and schools in Duke University have fellowships which are available to students pursuing appropriate studies. Departments should be consulted for further information.

Graduate Scholarships. Graduate Scholarships funded by Duke University are available to students in the departments of the Graduate School for study during the academic year. Awards are for full or partial payment of tuition and range in value to \$2,340. In 1973-1974, 94 students held Graduate Scholarships.

Summer Scholarships. A small number of Summer Scholarships which provide a payment of \$400 are available to students who are engaged in full-time study during the summer session. Interested students should consult their director of graduate studies.

Assistantships

Graduate Assistantships. Appointments as graduate assistants carry a total stipend up to \$4,530 for the academic year. The value of the stipend is determined by the fraction of time given to assisting, the qualifications of the assistant, and the nature of work assigned. In 1973-1974, 260 students held Graduate Assistantships.

Research Assistantships. Appointments are for predoctoral candidates whose special training and qualifications enable them to serve as assistants to individual staff members in certain departments. Stipends may be up to

\$4,380 depending on the assisting time required. In 1973-1974, 142 students held Research Assistantships.

Part-time Instruction. Several departments offering graduate work make use of exceptionally qualified graduate students as part-time instructors, tutors, and teaching assistants. These students are usually able to register for a graduate program of 9 units a semester.

Payment of Awards

The payment of stipends to graduate students holding awards starts on September 30 and is made in nine equal monthly payments on the last working day of each month thereafter. The Controller of the University has sole responsibility for paying all stipends to students.

Ordinarily stipends awarded under fellowships and scholarships are not subject to income and Social Security tax. However, a portion of the award to graduate assistants and research assistants may be subject to both. The Graduate School Office will supply detailed information.

Loans

It is the policy of Duke University to provide loans when needed to help students meet their educational expenses. Only students with full-time status who can demonstrate need according to established guidelines are eligible for loans. Loan funds are provided through the Federally Guaranteed Student Loan Program and the National Direct Student Loan Program. There are also loan funds under institutional control and deferred tuition loans. Generally loans made from these funds bear no interest charge to qualified borrowers while they maintain student status and for a short period thereafter. Interest during the repayment period is at a generally favorable rate. Any student wishing to apply for a loan must, as a first step, complete a Graduate and Professional School Financial Aid Statement (GAPSFAS) form. If this form has been completed in connection with a loan application to another institution, the student may request a copy of the analysis be sent to the Graduate School instead of again completing the form. An analysis of financial need will be made on the basis of the information from the GAPSFAS form. Additional information may be required of students who do not qualify as financially independent of their parents. GAPSFAS and other forms which accompany loan applications may be obtained on request from the Graduate School Office. Loan applications should be made prior to July 1 for the subsequent academic year.



Registration and Regulations

Registration

Who Must Register. All students must register (1) who enter course work or residence for credit; (2) who have completed minimum requirements for an advanced degree, but continue to use the facilities of the University in their research; (3) who have in *absentia* status; or (4) who wish merely to audit a course or courses.

Registration Periods. After receiving notification of admission to the Graduate School and returning a statement of acceptance of admission, the student may register at the first scheduled registration period. During the registration periods, announced in this Bulletin, the student first confers with the director of graduate studies of his major department who prepares and signs a course card listing the course work to be taken during the semester. The student then presents this course card to registration officials for enrollment in the selected courses. After a student's first registration he must register for subsequent semesters at the regular, stated time for registration. Currently enrolled students who fail to register at the first scheduled registration period for the subsequent semester incur a penalty for late registration. Former students who intend to register to resume a degree program must give the department and the Dean notice of this intention two months before registration.

Late Registration. All students are expected to register at the times stated in this Bulletin. A late registration fee of \$10.00 is charged to all students registering late, including current students who, (1) delay registering until the special registration for new students or, (2) must register in *absentia*.

Change of Registration. During the academic year within a period of two weeks from the day of registration, registration may be changed with the approval of the director of graduate studies if no reduction in fee is entailed, or if fees are to be refunded, only with the approval of the Dean. For the succeeding two weeks, the only permissible change is dropping course-seminar

registration and adding equivalent units of research, with the approval of the director of graduate studies, the instructor of the course, and the Dean. A period of five weeks from the date of registration is provided for changes resulting from passing a preliminary examination.

Academic Regulations

Residence.* Although graduate study consists principally of individual reading, research, and laboratory experimentation under guidance, academic progress in the United States is generally measured and recorded in terms of course hours and credits. Credit for courses and seminars, research, and residence, and corresponding tuition and fees are stated in terms of units. One unit is equivalent to one semester hour. The term residence designates full-time study and research in close proximity to the facilities provided, as opposed to part-time study incidental to a full-time occupation. For purposes of satisfying the residence requirement of the various degrees, residence of one year is defined as two successive academic semesters of no less than 9 units registration each semester. (See the chapter on Graduate Study in the Summer Session for residence required of master's candidates engaged solely in summer study.)

Faculty Ruling. No member of the instructional staff who is a candidate for a degree in the Graduate School of Duke University can hold a faculty rank above that of instructor.

Course Load. A graduate student is considered fully registered when he enrolls for the number of credits his program requires. Required registration is set in consideration of the student's obligation to teach or assist and the stage he has reached in fulfilling his degree requirements. In the academic year normal registration for the resident doctoral student who does not hold an appointment as part-time instructor or assistant or does not engage in part-time work is 15 units a semester or 30 units an academic year. The normal registration for the resident doctoral student who holds such an appointment or undertakes such work is either 12 units or a minimum of 9 units, depending upon the number of hours a week he is required to devote to such duties. The resident doctoral student carries such normal registration through the semester in which he passes the preliminary examination. If he remains in residence, he continues to register for a minimum of 3 units a semester until the dissertation is accepted. If he elects to go out of residence, he registers for 1 unit a semester in *absentia* in order to keep his program active.

The resident student engaged in a master's program requiring a thesis registers as though he were a resident doctoral student. However, once he has completed all requirements except the thesis, he may reduce his registration to the 3 units per semester, provided he is not proceeding to doctoral work at Duke. If he decides to go out of residence, he registers for 1 unit in *absentia*. Regulations pertaining to a resident student engaged in a master's program requiring no thesis are identical to those described above for the doctoral student up to and including the semester in which his course requirements are satisfied. At that point, he may reduce his registration to the number of hours necessary for completion of his degree program.

In each term of the summer session 6 units is maximum registration. Students who are in residence during the academic year and wish to continue study and the use of University facilities including the Student Health service

*See also section on Program Information.

during the summer must register for one unit in the first summer session term. This registration provides use of these facilities for all three terms of the summer session.

The registration of 1 unit a semester in *absentia* provides occasional consultation with the thesis or dissertation supervisor. It may be waived for military duty or serious problems of health. Except in the semester in which a final examination is scheduled, every student is allowed two semesters of *in absentia* registration without fee provided that the student is a master's degree candidate who has completed his course and language requirements or is a doctoral candidate who has passed his preliminary examination. The student qualifying must register at the proper time each semester as *in absentia*-no fee. The student who takes advantage of this provision while completing a master's program may not again use it should he proceed into a doctoral program.

It is necessary to be a fully registered student according to the regulations listed above in order to establish eligibility for library carrel and laboratory space, student housing, University and some outside loans, and the Student Health Service (including accident and sickness insurance; see section on Student Life).

Credits. The following regulations pertain to credits earned outside of the Duke University Graduate School:

Graduate Credit Earned before the A.B. Degree is Granted. Ordinarily no credit will be allowed for graduate courses taken before a student has been awarded his A.B. or B.S. degree. However, an undergraduate student at Duke University, who at the beginning of his final semester lacks no more than 9 semester hours of fulfilling the requirements for the A.B. or B.S. degree, may obtain permission from the Dean of the Graduate School to enroll for graduate courses to bring his total program to 15 hours a week. Such graduate courses will be credited toward the A.M., M.S., M.B.A., M.Ed., or M.A.T. degree, provided that the student meets the requirements for admission to the Graduate School, and that he is duly registered in the Graduate School at the beginning of the semester in which he intends to earn graduate credit.

Transfer of Graduate Credits. Credit for graduate course work earned at another institution will be determined only after a student has spent one semester at Duke University. After completing his first semester, the student should file a request, approved by his director of graduate studies, that his credits be reviewed and a decision be made.

Graduate Credit for Courses Taken in the School of Law. Upon the recommendation of the director of graduate studies, and upon the approval of the Dean of the Graduate School, students in the social sciences may take certain courses in the School of Law for graduate credit. In some instances courses in the School of Law may be considered as fulfilling a student's requirements for related work. To register for such courses, the student should present a letter from his director of graduate studies to the Dean of the School of Law requesting permission to register for specific courses.

Reciprocal Agreements with Neighboring Universities. Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh, students properly enrolled in the Graduate School of Duke University during the regular academic year, and paying full fees to this institution, may be admitted to a maximum of two courses per semester at one of the institutions in the cooperative plan. Under the same arrangement, students in the graduate schools in the neighboring institutions may be admitted to course work at Duke University. All inter-

institutional registrations involving extra-fee courses or special fees required of all students will be made at the expense of the student and will not be considered a part of the Duke University tuition coverage.

Identification Cards. Graduate students are issued two-part identification cards which they should carry at all times. The cards are the means of identification for library privileges, university health services, athletic events, and other University functions or services open to them as University students. Students will be expected to present their cards on request to any University official or employee.

The cards are not transferable, and fraudulent use may result in loss of student privileges or suspension. A student should report the loss of this card immediately to the Registrar's Office. The cost of a new ID card is \$5.00.

Grades. Grades in the Graduate School are as follows: *E*, *G*, *S*, *F*, and *I*. *E* (exceptional) is the highest mark; *G* (good) and *S* (satisfactory) are the remaining passing marks; *F* (failing) is below passing; and *I* (incomplete) indicates that some portion of the student's work is lacking, for an acceptable reason, at the time grades are reported. The instructor who gives an *I* for a course specifies the date by which the student must have made up the deficiency, in no case more than one calendar year from the date the course ended. If the course is not completed, the grade of *F* is normally entered upon the student's record. The grade of *Z* indicates satisfactory progress at the end of the first semester of a two-semester course. It will be changed to whatever grade is appropriate upon the completion of the course. A grade of *F* in a major course normally occasions withdrawal from a degree program not later than the end of the ensuing semester or term; a grade of *F* in any other course occasions academic probation.

Courses Primarily for Undergraduates. Students granted provisional admission and others whose preparation is found deficient may on occasion be required as part of their program to take undergraduate courses as prerequisites to continued graduate study. Undergraduate courses thus taken and others elected by the student will carry no graduate credit.

In exceptional cases, 100-level courses outside the major department may be taken for graduate credit to a maximum of two one-semester courses or one year-course not exceeding a total of 8 units, when approved by the director of graduate studies in the major department and in the department in which the course is listed, and by the supervisor of the program. In order to receive credit for any such undergraduate work, the graduate student must earn a grade of at least *B*. Graduate students registering for undergraduate courses will be assessed 3 units for a non-laboratory course and 4 units for a laboratory course.

Withdrawal from a Course. For permissible changes during the first four weeks after the registration date, see Change of Registration. If a course is dropped without the necessary approval, the permanent record will list the course as Dropped Unofficially, *F*. If a course is dropped after the four-week period, the status of the student at the time of withdrawal from the course will be determined and indicated on the permanent record as Withdrew Passing (WP) or Withdrew Failing (WF).

Interruption of Program and Withdrawal from the Graduate School. The University reserves the right, and matriculation by the student is a concession of this right, to request the withdrawal of any student whose academic performance at any time is not satisfactory to the University. If a student wishes for any reason to withdraw from the Graduate School, he should notify both the director of graduate studies in his major department and the Dean of the Graduate School prior to the date of his expected withdrawal.

(For refunds upon withdrawal, see the section on Tuition and Fees. For withdrawal occasioned by academic failure, see above.)

Students who find it necessary to interrupt their program of study for a period longer than a summer vacation should, before departure, leave with the Graduate School Office a statement of the reason for interruption, mailing address, and expected date of return. If they are subject to registration in absentia, they should arrange for such registration before departure.

A foreign student who after successfully completing a minimum of one semester's graduate study must withdraw for the purpose of returning home before the completion of a graduate program may with the approval of his major department request the Dean to issue him a Certificate of Graduate Study.

Size and Make-up of Classes. Classes which carry graduate credit are limited in size to thirty students. In exceptional cases this regulation may be modified, but only by permission of the Dean of the Graduate School. Courses numbered from 200 through 299 may have not only graduate students enrolled but also an unspecified number of sophomores, juniors, and seniors, provided the undergraduates have the approval of both the course instructor and the director of graduate studies. Undergraduate students are not permitted to enroll in 300-level courses.

Language Requirements. Although individual departments have the right to establish their own minimal requirements (see individual departmental headnotes in this Bulletin, the regulations of the Graduate School require no language for the master's degree, and, in most departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. With the special approval of the Dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. degree may be waived in individual cases or with respect to all students in a given department, provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the students concerned. The languages normally taken are French, German, and Russian. A student may substitute for any one of these another language which has a definite relation to his degree program and for which an examination can be provided. A foreign student whose native language is not English may request that the director of graduate studies in his department ask permission of the Dean of the Graduate School to offer English for the foreign language required in his program. (See calendar at the beginning of this Bulletin for the scheduled dates of the appropriate examination in English.)

To avoid unnecessary delays, prospective students should anticipate the language requirement of their degree programs. For example, students whose programs call for a knowledge of French, German, Russian, or Spanish are urged to take the appropriate Educational Testing Service (ETS) Graduate School Foreign Language test prior to registration. It should be noted, however, that at the time of the final examination in a master's program or of the preliminary examination in a doctoral program, language examinations more than six calendar years old will not be accepted toward fulfilling the language requirement.

Meeting the Requirement. The foreign language requirement may be satisfied in the following ways:

1. The student may take one of the ETS examinations administered to undergraduate and graduate students at many national centers (including the Duke University Counseling Center). The examination may be taken no longer than six years before the preliminary examination.
2. With the permission of the Dean of the Graduate School, the director



of graduate studies may request transfer acceptance of a language examination passed prior to the student's enrollment at Duke. The student should request that a transcript or other certification that the language was passed be sent to the Graduate School for approval. The limitations are that (a) only one language of a doctoral requirement may be met in this way, (b) the other institution offers a doctoral program in the student's major and the examination would have met a doctoral requirement there, and (c) the examination was passed no more than five years before first registration here.

3. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School Office and administered by a qualified examiner.

4. In special circumstances, a reading examination in any foreign language may be administered by a qualified member of the faculty under a procedure specified by a department and approved by the Dean and the Executive Committee of the Graduate Faculty.

Requirements for Foreign Students. Foreign students whose native language is not English are, during their first registration period, required to take a test for minimum competence in English. Such students, with the approval of the director of graduate studies in their major department, may request permission of the Dean of the Graduate School to substitute English for the one foreign language required in the master's or doctoral program. If permission is granted, an additional advanced-level reading test in English will be arranged. (See Admission Procedure for Foreign Students.)

Special Reading Courses. Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week; French during the fall semester and occasionally also in the spring, German during the spring semester and the summer session. A student who registers for either course must reduce his normal load of graduate courses by 3 units, with no reduction in fees. No auditors are permitted in these courses at any time. Undergraduates may not enroll during the academic year but may register in the summer with permission of the Dean of the Graduate School, provided total registration permits.

Undergraduate Language Courses. Students whose programs require them to take elementary language courses numbered below 200 receive no graduate credit for the work so taken.

Commencement

At commencement exercises in May degrees are awarded to those who have completed requirements at the end of either of the two regular semesters of the academic year. Those who complete degree requirements at the end of a summer term become eligible to receive diplomas dated September 1, but no commencement exercises are held for such graduates, and the diplomas are mailed in December, after final approval by the University Faculty and Trustees.

Standards of Conduct

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as currently in effect or, as from time to time, are put into effect by the appropriate authorities of the University.

Judicial Code and Procedures. In the spring, 1971, the Graduate School Community ratified and adopted the following official judicial code and procedures:

I. Graduate School Judicial Code and Procedures

- A. A student, by accepting admission to the Graduate School of Duke University, thereby indicates his willingness to subscribe to and be governed by the rules and regulations of the University as currently in effect or, from time to time, put into effect by the appropriate authorities of the University, and he indicates his willingness to accept disciplinary action, if his behavior is adjudged to be in violation of those rules or in some way unacceptable or detrimental to the University. However, a student's position of responsibility to the authorities and the regulations of the University in no way alters or modifies the responsibilities that are his in relation to civil authorities and laws.
- B. A graduate student at Duke University stands in a primary and unique relation of responsibility to the faculty in his major department, the faculty upon whose recommendation a graduate degree will or will not be awarded to the student. In matters which involve or may affect the student's intellectual or professional life, the student is directly responsible to this department and its representatives, and such matters should primarily be handled by the department.
- C. Actions which appear to conflict with University-wide rules and regulations will fall under jurisdiction of the University Judicial Board.
- D. A student may elect to have the Dean of the Graduate School hear matters related to the student's conduct in addition to or instead of faculty members from the student's major department, or he may elect to have such matters reviewed and judged by a judicial board instead of the Dean of the Graduate School or members of the faculty in his major department. (The constitution and procedure of the judicial board are detailed below under "The Graduate School Judicial Board.")
- E. The Director of Graduate Studies in the student's major department may request that a student's actions be reviewed by the Judicial Board or by the Dean of the Graduate School.

II. The Graduate School Judicial Board

- A. Composition. The Graduate School Judicial Board shall have five members, serving for a period of two years: two students selected from the student body, two members of the Graduate Faculty appointed by the Executive Committee of the Graduate School, and one Associate or Assistant Dean appointed by the Dean of the Graduate School. The Board shall elect one of its members as Chairman. The Board shall have at its service a recording secretary to keep minutes of the hearings and of the Board's actions in a permanent, confidential record book. The Board will be constituted in order to hear cases in which the accused is a student currently enrolled in the Graduate School and which have been referred to it by the Director of Graduate Studies in the student's department, by the Dean of the Graduate School, or by the student himself.
- B. Preliminary Procedures. If a student requests a hearing by the Judicial Board he must do so in writing, allowing its chairman at least 72 hours to convene the Board. In addition,

the chairman shall not convene the Board until 72 hours after he had been asked to convene the Board.

It is the responsibility of the Chairman of the Judicial Board fully to inform its members concerning the case and the reasons the case has been referred to the Board. In addition, he shall prepare a written summary of this information for the Board, the Dean, and the student.

C. Procedural Safeguards for the Hearing. The Accused has the right to challenge on the grounds of prejudice any member of the Judicial Board. If the Board decides to excuse one or more of its members for reasons given by the Accused, it shall consult with the Dean about the need for replacements.

The Accused may choose an Advisor to assist him in his defense. He may also produce witnesses (including no more than two character witnesses), introduce documents, and offer testimony in his own behalf.

A person having direct knowledge relevant to a case being heard by the Board is a material witness. The Judicial Board may request the appearance of material witnesses. The Board shall also request, upon written request of the Complainant or the Accused, the appearance of material witnesses. Witnesses shall be notified of the time, place, and purpose of their appearance.

The Accused has the right to examine the written statement of any witness relevant to his case at least 72 hours before the hearing. He has the right to be faced by any witness who has given a statement relevant to his case at the hearing if the witness's attendance can be secured.

The hearing will be conducted in private unless the Accused requests an open hearing. If any objection is raised to conducting an open hearing in any particular case, the Judicial Board shall decide the issue by majority vote. If the decision is made not to hold an open hearing, the Accused shall be informed in writing of the reasons for the decision.

The Judicial Board shall consider only the report of the chairman, documents submitted into evidence, and the testimony of witnesses at the hearing in reaching its decisions.

D. Conduct of the Hearing. The hearing of any case shall begin with a reading of the charge by the chairman in the presence of the Accused. The Accused shall then plead guilty or not guilty or move to terminate or postpone the hearing. The Accused may qualify a plea, admitting guilt in part and denying in part.

The Accused may not be questioned for more than one hour without recess.

At any time during the hearing, the Accused or the Judicial Board may move to terminate or to postpone the hearing or to qualify his plea or to modify its charge.

Pending verdict on charges (including appeal) against the Accused, his status as a student shall not be changed, nor his right to be on campus or to attend classes suspended, except that the Chancellor or Provost may impose an interim suspension upon any member of the University community who demonstrates, by his conduct, that his continued presence on the campus constitutes an immediate threat to the physical well-being or property of members of the University community or the property or orderly functioning of the University.

E. Sanctions and the Verdict. The Graduate School Judicial Board shall have the power to impose the following penalties: expulsion, dismissal from the University with the recommendation that the person never be readmitted; Suspension, dismissal from the University and from participation in all University activities for a specified period of time, after which the student may apply for readmission; Disciplinary Probation, placing the student on a probationary status for a specified period of time, during which conviction for violation of any regulation may result in more serious disciplinary action; Restitution, payment for all, or a portion of property damage caused during the commission of an offense. Restitution may be imposed by itself or in addition to any of the other penalties.

The Judgment shall consist of a finding of guilty or not guilty of the charge and, when the Accused is found guilty, a statement of the punishment assessed. On all questions, including the verdict and the finding of guilty or not guilty, the Board shall be governed by a majority vote.

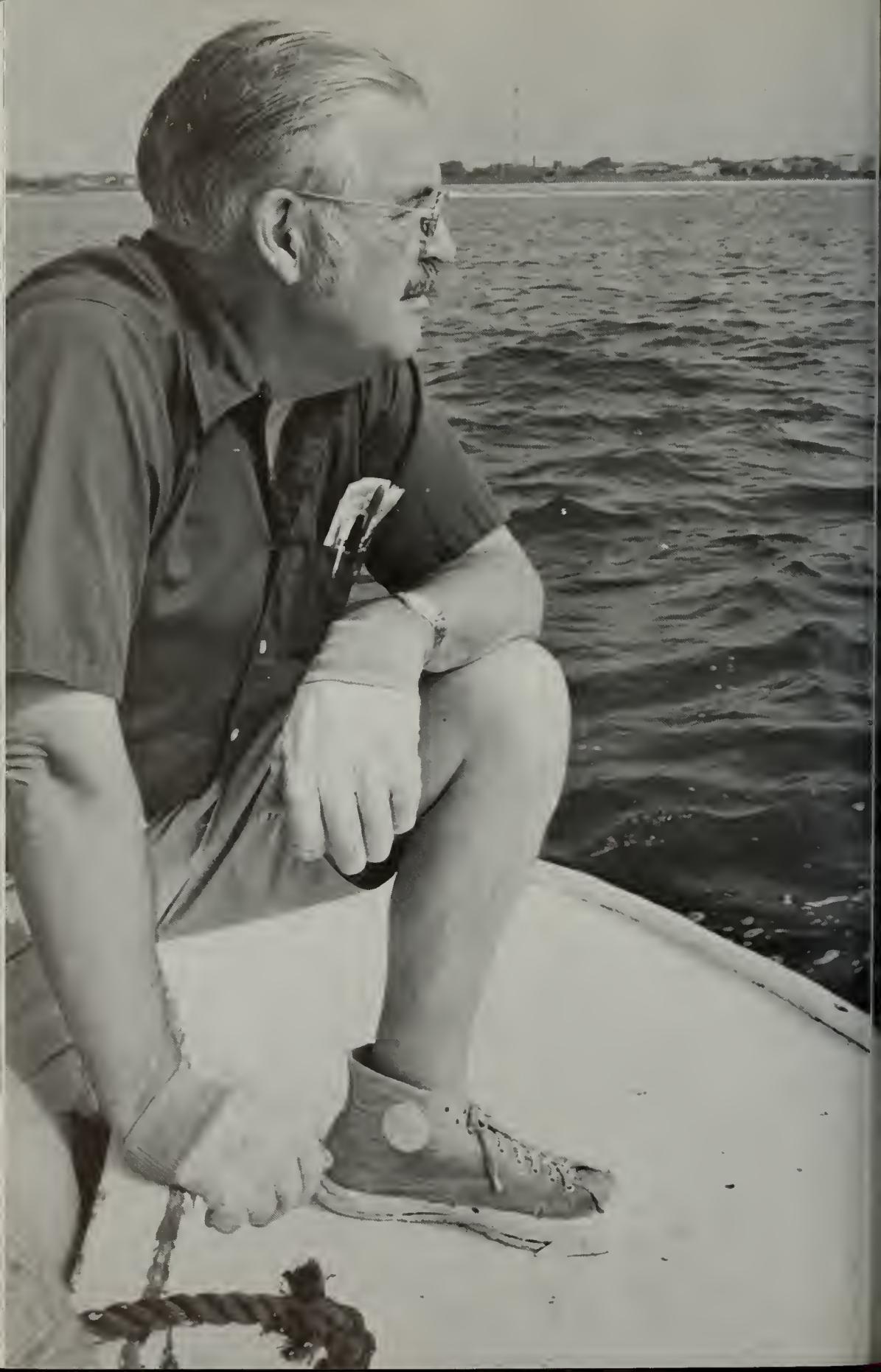
The Judicial Board may decide to rehear a case in which significant new evidence can be introduced. In addition, the defendant may request an appeal.

F. Appeals. The appellant may submit to the Dean a written statement containing the grounds for his appeal and his arguments. In such cases, the Dean should determine if the appeal should be granted, and he can hear the case himself, or refer it to the appropriate faculty in the student's department or to the Judicial Board.

An appeal shall be granted on the following grounds: procedural error substantially affecting the rights of the Accused; incompatibility of the verdict with the evidence; excessive penalty not in accord with "current community standards"; new evidence of a character directly to affect the judgment but on which the original tribunal had refused a new hearing.

III. Amendment and Construction

This Judicial Code and Procedure and this constitution and procedure for the Graduate School Judicial Board may be amended at any time with due notice or publication by consent of the Dean, the Executive Committee, and the graduate students. Questions and problems not answered or anticipated by the foregoing may be resolved by the use of other existing institutions or by amendment.



Study in the Summer

Programs Offered

The 1974 Summer Session of Duke University will consist of three terms. The first term will begin on May 14 and will end on June 15. The second term will begin on June 17 and will end on July 17. The third term will begin on July 18 and will end on August 17.

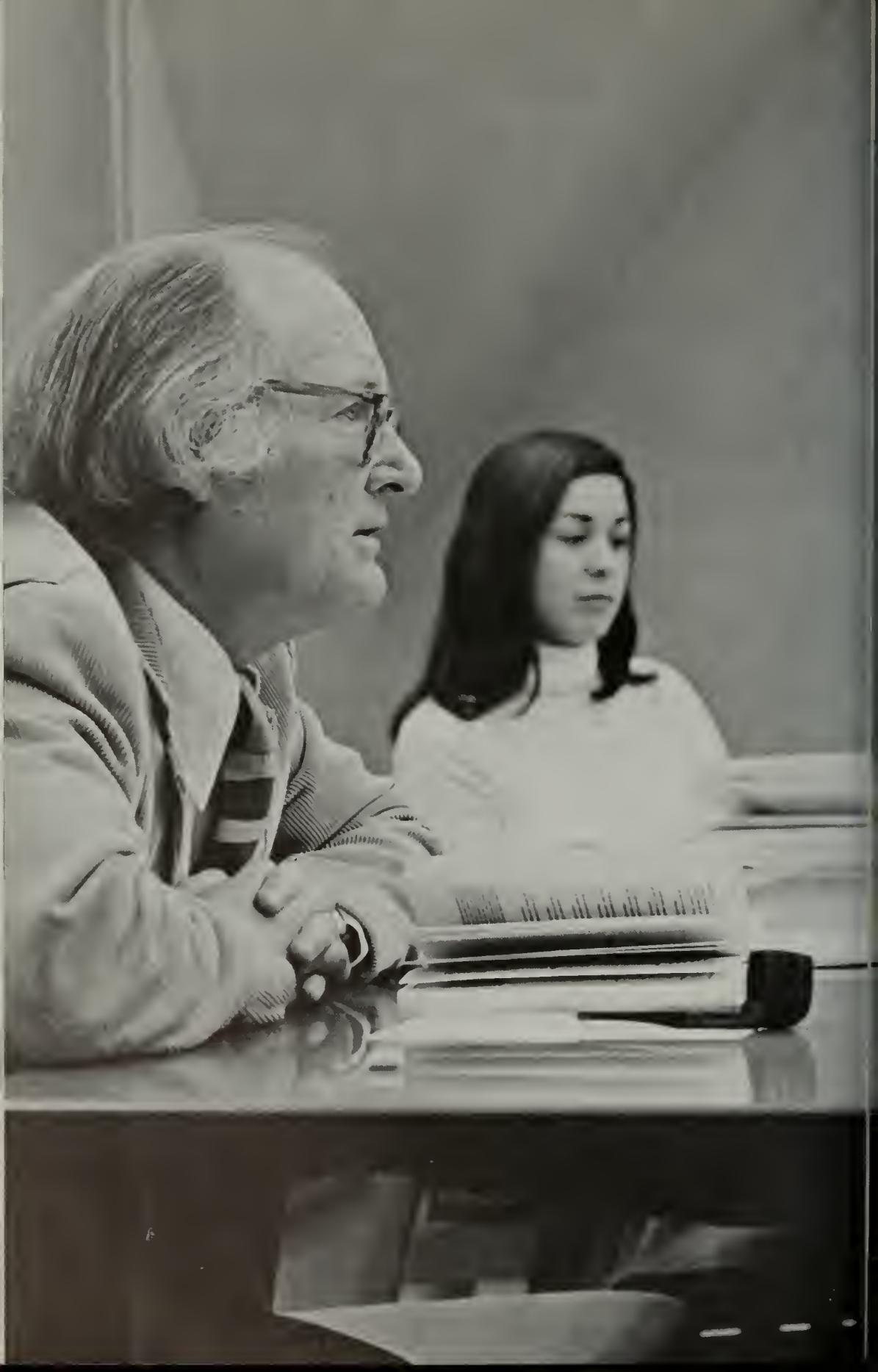
Graduate students who wish to work toward advanced degrees in the summer session, particularly in chemistry, economics, education, English, history, mathematics, religion, sociology, and zoology, will find a selection of courses offered by members of the Duke faculty and by visiting professors. Other departments ordinarily offering work leading to the A.M. degree are botany, political science, and psychology. Thesis research for advanced graduate students is available also in most other departments, such as Engineering, Forestry, and Physics.

Students who wish to be admitted to the Graduate School for work in the summer session should make application to the Dean of the Graduate School, as well as to the Director of the Summer Session, and should return the completed application, with supporting documents, before April 15 for admission to Term I; before May 15 for admission to Term II; and before June 15 for admission to Term III. (See the section on Admission.)

Regulations Regarding Summer Work

No graduate student may register for more than 6 units of credit in one summer session term. All of the work required for the master's degree must be completed within six years of the date of matriculation. No residence credit can be accepted toward the requirement for the Ph.D. degree for work completed during the summer sessions. Students who complete during the summer session the work required by the University for an advanced degree will be granted the degree in September.

The Bulletin of the Summer Session, containing information about graduate courses, may be obtained by writing to the Director of the Summer Session, Duke University, Durham, North Carolina 27706.



9

Courses of Instruction

Course Enrollment

In general, courses with odd numbers are offered in the fall semester, those with even numbers in the spring semester. Double numbers separated by a hyphen indicate that the course is a year course and must normally be continued throughout the year if credit is to be received. A student must secure written permission from the instructor in order to receive credit for either semester of a year course. Double numbers separated by a comma indicate that although the course is a year course, credit may be received for either semester without special permission. Normally, courses which bear no date are offered every year.

Note: In each department the number 399 is reserved to designate special (individual) readings in a specified area and supervised by a regular member of the graduate staff, with credit of one to three units each registration, only one course per registration, and nine units maximum in three successive registrations. The course is restricted to resident master's and doctoral programs, must have a completion exercise, and must carry a grade.

Anatomy

Professor Robertson, Chairman (Room 466, Sands Building); Assistant Professor Adelman, Director of Graduate Studies (Room 270, Sands Building); Professors Everett, Moses, and Peele; Associate Professors Counce, Duke, Longley, and Reedy; Assistant Professors Bergeron, Blake, Cartmill, Erickson, Hall, Hylander, Johnson, and Mahaley

The Department of Anatomy offers graduate programs designed to produce teachers and research workers competent in a broad range of anatomical sciences; both A.M. and Ph.D. degrees are offered. Students with a wide variety of backgrounds and interests in the biological sciences can be accommodated. All students participate in a core anatomical sciences course (Anatomy 301) and gain experience in teaching over the range of de-

partmental interests. Students are encouraged to round out their formal course work by drawing upon the offerings of other departments in the University, as well as those in the Anatomy Department. Laboratories within the department are equipped for and actively support research in several areas. Some idea of the opportunities for degree research may be gleaned from the description of Anatomy 312. For further information contact the Director of Graduate Studies.

207. Human Anatomy. A lecture-laboratory discussion course that examines human morphology and the fundamental relationships among the neurologic, musculo-skeletal, cardiovascular, gastrointestinal, respiratory renal, and reproductive systems. The course includes cadaveric presentations of every major region of the human body. Intended primarily for students in allied health programs. Prerequisite: permission of instructor. Credit variable; maximum 3 units. *Blake and Staff*

208. Anatomy of the Trunk. Designed for Ph.D. candidates in anatomy as well as general practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisite: core course in anatomy. Number of students arranged by staff. 2 units. *Duke*

215. Contractile Processes. Cellular and molecular basis of activity in cilia and skeletal, cardiac, and smooth muscle; submicroscopic structure and behavior of muscle; electrical and ionic properties of muscle membranes; electro-mechanical coupling; mechanics and thermodynamics of muscular contraction; biochemical energies of contraction; contractility research. Prerequisite: permission of instructor. (Also listed as Physiology 216.) 3 units. *Reedy, Anderson, Jobsis, and Johnson*

219. Molecular and Cellular Basis of Development. A multidisciplinary approach stressing the molecular, cellular, and genetic processes involved in development and differentiation in pro- and eukaryotes. Topics include: initiation of development, morphogenesis, developmental genetics, differentiation, and nuclear-cytoplasmic interactions in development. (Also listed as Biochemistry 219, Microbiology 219, Pathology 219, and Physiology 230.) 3 units. *Counce, Johnson, McCarty, Luftig, Padilla, and Sommer*

219S. Seminar. Optional seminar offered in conjunction with Anatomy 219. Students prepare and present seminar topics directly related to specific subjects discussed in Anatomy 219. Prerequisites: enrollment in Anatomy 411 and permission of instructors. 1 unit.

231. Human Evolution. Evolutionary biology of the primates. Anatomical and behavioral adaptations and phylogeny of fossil and living primates including *Homo sapiens*. Prerequisite: Anthropology 93 or equivalent. (Also listed as Anthropology 231.) 3 units. *Cartmill*

238. Function and Evolutionary Morphology of Primates. History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Prerequisite: Anatomy 231 (Anthropology 231) or equivalent, or consent of instructor. (Also listed as Anthropology 245.) Offered spring, 1975, and alternate years thereafter. 3 units. *Hylander and Cartmill*

240. Mechanisms of Biological Motility. Discussions, based on extensive readings, on the ultrastructure and biochemistry of biological motile systems. Introductory discussions of muscle contraction and sperm-cilia-flagella will form the basis for subsequent consideration of such weekly topics as amoeboid motion, fibroblast motility, protoplasmic streaming, mitosis, particle saltations, etc. Emphasis placed on defining similarities between systems with different phenomenologies of motion. Ends with a series of brief student seminars on topics from areas not covered in the prin-

ciple seminars. Prerequisite: written permission of the instructor. Enrollment minimum 4; maximum 10. 3 units. Offered spring, 1975, and alternate years thereafter. Adelman

246. The Primate Fossil Record. (Also listed as Anthropology 246.) 3 units. Cartmill and Staff

261. History of Generation and Mammalian Reproduction. Theories of generation and of historical development of present-day concept of mammalian reproductive processes. Prerequisite: consent of instructor. Offered fall, 1975, and alternate years thereafter. (Alternates with Anatomy 263.) 1 unit. Duke

263. History of Anatomy. The lives and contributions of the founders of anatomy, Aristotle to the twentieth century. Prerequisite: consent of instructor. Offered fall, 1974, and alternate years thereafter. (Alternates with Anatomy 261.) 1 unit. Duke

264. Mammalian Embryology and Developmental Anatomy. Study of early embryology and organology of mammals, using the rat as the basic form, supplementing it with other mammalian forms, including primates. Prerequisites: one year of zoology and consent of instructor. 4 units. Duke

266. Topics in Cell Structure and Function. Advanced discussions of selected problems such as chromosome structure, mitosis, and cytological aspects of inheritance and development. Prerequisites: Zoology 160 or Zoology 260 or equivalent and permission of instructor. (Alternates with Anatomy 288 and Zoology 288.) (Also listed as Zoology 266.) Offered spring, 1974, and alternate years thereafter. 2 units. Moses and Nicklas

276. Comparative Neurology and Psychology. Variations among brains of different vertebrate species will be correlated with genetic lines of descent and the behavioral requirements of different habitats. Prerequisite: permission of instructor. (Also listed as Psychology 276.) 3 units. Hall

280. Molecular Basis of Anatomy. Lectures and conferences on the molecular structure of biological macromolecules and their organized aggregates such as are found in viruses, muscles, membranes, and other intracellular organelles, with emphasis on the results of electron microscopy, X-ray diffraction, and optical analysis. Prerequisites: microscopic anatomy or cytology (or equivalent) and permission of instructor. Offered spring, 1975, and alternate years thereafter. (Alternates with Anatomy 286.) 3 units. Longley, Adelman, Erickson, Moses, Reedy, and Robertson

286. The Light Microscope, the Electron Microscope, and X-ray Diffraction in Biology. Lectures and laboratories on methods of ultrastructure research. Fundamentals of optics; the light microscope, phase, polarizing, and interference microscopy. Basics of electron microscopy, staining, sectioning, and replication techniques. Optical and computer image processing. Introduction to X-ray diffraction theory and apparatus in structure determination. Prerequisites: microscopic anatomy or cytology (or equivalent), calculus and one year each of physics and general chemistry; permission of instructor. Offered spring, 1976, and alternate years thereafter. (Alternates with Anatomy 280.) 4 units. Longley, Erickson, Moses, Reedy, and Robertson

288. The Cell in Development and Heredity. A seminar on topics of current interest and controversy. Prerequisites: a course in genetics and permission of instructor. (Alternates with Anatomy 266 and Zoology 266.) (Also listed as Zoology 288 and under the University Program in Genetics.) Offered spring, 1975, and alternate years thereafter. 2 units. Counce and Gillham

291. Special Topics in Nerve Ultrastructure. Each student chooses a topic, such as ultrastructure of synapses, or sensory nerve endings includ-

ing the retina, of auditory nerve, of simple nerve nets, or morphological correlates of learning. Each student pursues his topic in the library during the first half of the semester with guidance from the instructor in order to prepare a detailed paper. The second half of the semester is devoted to seminar presentations and discussions of the selected topics. Enrollment: minimum 5. 2 units. Robertson

300. Gross Anatomy. Gross anatomy for physical therapy students. Credit to be arranged; maximum—8 units. Blake and Staff

301. Gross Human Anatomy, Microscopic Anatomy, and Neuroanatomy. Gross anatomy includes complete dissection of a cadaver; laboratory work is supplemented by conferences which place emphasis upon biological and evolutionary aspects. Microscopic anatomy will emphasize the cell, its generalized structural and functional organization down to the molecular level, and differentiations of the cell in various organs and tissues. Students will be introduced to light and electron microscopic and diffraction methods for investigating biological structure. Neuroanatomy will first present the gross and basic intrinsic anatomy of the central nervous system. Later, specific systems will be emphasized: various sensory and motor; limbic-hypothalamic; and cerebral-associated mechanisms. Clinical presentations will be offered. Prerequisites: adequate background in biology, including comparative anatomy and embryology, and written permission of the Director of Graduate Studies. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. Hours and credit by arrangement; maximum—8 units. Staff

303. Neuroanatomical Basis of Behavior. A study of the gross and microscopic anatomy of the nervous system with emphasis on the structural and functional relationship between tracts, nuclei, and cortical areas. 3 units. Hall and Peele

312. Research. Individual investigations in the various fields of anatomy. Laboratories in which a student may work include: three electron microscopy laboratories headed by Moses, Reedy, and Robertson with emphasis respectively on the fine structure and cell biology of chromosomes and associated structures, molecular structure and function of muscle, and biophysical studies of the cell membrane and nervous tissue; physical anthropology laboratory and Primate Facility under Bergeron, Cartmill, and Hylander, concentrating on cytogenetics, comparative anatomy, and primate evolution and behavior; neuroanatomy laboratories under Peele and Hall emphasizing structural correlates of behavior and learning; neuroendocrinology laboratories under Everett and Blake with emphasis on brain mechanisms regulating reproductive functions of the pituitary gland; a human reproduction laboratory under Duke studying ovarian structure and function; developmental biology laboratories under Counce and Johnson with emphasis on insect and amphibian morphogenesis and the relationships of cell membrane contact phenomena to differentiation; a cell biology laboratory under Adelman emphasizing biochemical aspects of primitive motility and the structure and function of membranes; and molecular structure laboratories under Erickson and Longley using a combination of electron microscopy, X-ray diffraction, and optical and computer methods of image analysis. Credits to be arranged. Permission of staff required. Maximum—6 units. Staff

313, 314. Anatomy Seminar. Regular meeting of graduate students and staff in which current research problems in anatomy will be presented. 1 unit per semester. Staff

334. Topics in Physical Anthropology. Reading and discussion of recent research. Prerequisite: Anatomy 231 (Anthropology 231 and Zoology 231). (Also listed as Anthropology 334.) Offered spring, 1975, and alternate years thereafter. 3 units. Cartmill and Staff

340. Tutorial in Advanced Anatomy. Topics for intensive reading and discussion will be chosen according to the student's interests, related to basic problems in biophysics, cytology, endocrinological control, growth and development, neuroanatomy, physical differentiation, and evolutionary origins of functional micro-systems. Maximum enrollment—8. Prerequisite: permission of instructor. 3 units. Staff

344. Advanced Neuroanatomy of Sensory and Motor Mechanisms. The course will involve consideration of classic and modern concepts of somatic and special sensory systems and of somatic and visceral motor systems. Clinical correlations of basic neuroanatomy will be included. Minimum enrollment—5; maximum—20. 3 units. Peele

354. Research Techniques in Anatomy. A preceptorial course in various research methods in anatomy. An interested student might engage in research in one of the following: anthropology, electron microscopy, developmental biology, fetal physiology, primate behavior, primate anatomy, and stereotactic approaches to neuroendocrinology and neuroanatomy. Other topics may be arranged. Prerequisite: permission of instructor. Units to be arranged. Staff

418. Reproductive Biology. (Also listed as Physiology 418.) 2 units. Anderson, Blake, Everett, and Schomberg

Anthropology

Professor Friedl, Chairman and Director of Graduate Studies (346A Sociology-Psychology Building); Professors Fox and LaBarre; Associate Professor Apte; Assistant Professors Cartmill, Casson, Hylander, O'Barr, and Quinn; Instructor Kress

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Record Examination Aptitude Test.

Candidates for the Ph.D. degree must demonstrate a general competence in four major sub-fields (sociocultural anthropology, physical anthropology, anthropological linguistics, and prehistory) as well as specialization in one or more of these sub-fields. Recognizing a trend in modern anthropology toward interdisciplinary research, the department allows the student to replace some of the course work required for the Ph.D. degree by advanced work in anatomy, economics, psychology, sociology, zoology, or other disciplines relevant to a student's program.

Further details of the graduate program in anthropology, the departmental facilities, the staff, and various stipends available are described in the Guidelines for Graduate Students in Anthropology which may be obtained from the Director of Graduate Studies for Anthropology, Department of Anthropology.

For Seniors and Graduates

220. Society and Culture in India. The basic features of Indian cultures and societies from an anthropological perspective. The impact of selected technological and social changes upon the individual, caste, and community. 3 units. Fox and Apte

222. Topics in African Anthropology. Current research problems in African anthropology, illustrated by a study of tribal societies, in terms of contemporary theories. 3 units. O'Barr

231. Human Evolution I. See course description for Anatomy 231. (Also listed as Anatomy 231.) Cartmill

242. Topics in Prehistory. Anthropological issues, derived from archeological and early historical investigations. Prerequisites: Anthropology 93 and 94 or equivalent. 3 units. Kress

243. Seminar in Theory and Method in Archaeology. In-depth study of modern archaeological methods stressing geochronology, environmental reconstruction, sociocultural reconstruction, and statistical analyses. These techniques will then be applied to problem areas in archaeology—human cultural origins, lower-to mid- and mid- to upper-paleolithic, post-Pleistocene readaptations, origins of agriculture and civilization. 3 units. Kress

244. Primate Behavior. Examination of the social behavior of prosimians, monkeys, and apes in an attempt to understand the evolutionary development of the primate order and the origin of man. 3 units. Kress

245. Functional and Evolutionary Morphology of Primates. See course description for Anatomy 238. 3 units. Hylander and Cartmill

246. The Primate Fossil Record. The evolution of man and his relatives in the primate order as inferred from the fossil remains of their extinct ancestors. Prerequisite: Anatomy 231 (Anthropology 231, Zoology 131) or equivalent, or permission of instructor. 3 units. Cartmill

249. Topics in Economic Anthropology. 3 units. O'Barr and Quinn

250. The Anthropology of Cities. The organization and behavior of men in cities are analyzed from an evolutionary perspective on the development of urban centers. The objective is a cross-cultural analysis of the nature of cities and their varying roles within the societies in which they occur. 3 units. Fox

251. Ethnography of Humor. Examination of theoretical framework, research methods and data-collection techniques for the analysis of humor with the goal of discerning normative behavioral patterns, expectations regarding social roles, interpersonal relationships and social institutions, and the nature of ideologies and world views, within and across cultures. Prerequisite: Anthropology 94 or permission of instructor. 3 units. Apté

259. Linguistic Anthropology: Language Acquisition. Biological basis of human linguistic capacity, major theoretical positions in linguistics, acquisition of semantics, and syntax and phonology in English and other languages. Prerequisite: permission of the instructor. 3 units. Casson

260. Linguistic Anthropology: Phonemics. Application of linguistic theory to analysis of language; concentration on the sound system of non-Western languages. Prerequisite: Anthropology 118 or permission of the instructor. 3 units. Apté and Casson

261. Linguistic Anthropology: Morphology and Syntax. Application of linguistic theory to analysis of language; concentration on the grammatical system of non-Western languages. Prerequisite: Anthropology 118 or permission of the instructor. 3 units. Apté and Casson

262. Anthropology of Law. Legal decision in pre-literate societies. The interrelationships of law and ritual. 3 units. Staff

263. Primitive Art and Music. A comparative ethnological study of the data and theories concerning non-European music and art; sufficient technical background will be provided for non-specialist students. Recordings, slides, and museum artifacts will be used. 3 units. LaBarre

264. Primitive Religion. The ethnology, social functions, and the socio-psychological meanings of religion in primitive societies. 3 units. LaBarre

265. Personality and Society. The developmental social psychology of human personality, its origin in the primary group, its nature and varieties and its integrations into secondary group institutions. Prerequisite: permission of the instructor. 3 units. LaBarre

266. Personality and Culture. The influence of culture patterns and social institutions upon character structure, socialization of the individual, and the dynamics of human personality. Comparative anthropological materials will be drawn upon. Prerequisite: permission of the instructor. 3 units. LaBarre

270. Seminar in Ethnographic Field Methods. Focus on preparation for and conduct of field research. Examination of research strategies and techniques for data collection as well as participation in a field project in a local community. 3 units. Casson, O'Barr, and Quinn

271. Seminar in Methods of Data Analysis. Quantitative analysis of anthropological data. 3 units. Quinn

275. Rank, Power, and Authority in Pre-Industrial Societies. Study of the role and development of social, economic, and political distinctions between men. A general perspective on social stratification from the sociological and anthropological literature will be presented, and then analyzed in relation to specific ethnographic examples drawn from Oceania, Africa, and the New World. Prerequisite: concentration in anthropology or graduate standing. 3 units. Fox

276. Analysis of Kinship Systems. Primitive relationship categories as related to legal norms and social groupings. Theoretical issues and contrasting approaches to the analysis of social classification terminologies. 3 units. Casson

278. Special Topics in Political Anthropology. Current research problems in political anthropology. Topic(s) will change each semester. 3 units. O'Barr and Quinn

280, 281. Seminar in Selected Topics. Special topics in methodology, theory, or area. Prerequisite: permission of the instructor. 3 units per semester. Staff

291, 292. Anthropological Theory. Theoretical, methodological, and comparative issues in anthropology. 3 units per semester. Fox and Quinn

For Graduates

330, 331. Seminar in Anthropology. A seminar for advanced students who wish to pursue individual studies in social and cultural anthropology. Offered both semesters. 1 to 3 units per semester. Staff

334. Topics in Physical Anthropology. See course description for Anatomy 334. (Also listed as Anatomy 334.) 3 units. Staff

335, 336. Linguistic Theory and Methods. Basic course for graduate students in the anthropology graduate program. 3 units. Apté and Casson

393. Individual Research in Anthropology. A course for the student preparing the A.M. thesis or the Ph.D. dissertation. Supervision and guidance of intensive research on a problem approved by the student's departmental advisory committee. 3 units. Staff

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. Goodwin, Holley, and Spragans

410. Seminar in the Government, History, and Social Structure of India and Pakistan. 3 units. Fox and Staff

Art

Professor Coví, Chairman; Professor Markman, Director of Graduate Studies; Professors Hall, Heckscher, Jenkins, Mueller, and Sunderland; Lecturer Langedijk

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required to attend prescribed undergraduate courses. A reading knowledge of one foreign language (preferably German) is required; candidates who do not meet this requirement upon admission to the program are expected to do so by the end of their first term in residence.

The program for the A.M. degree in art history consists of 30 units, as follows: 12 units in art history; 6 units in an approved minor; 6 units in the major or minor, or other approved subject; and 6 units in thesis. A written thesis is required. The candidate must also pass a written comprehensive examination testing his knowledge of art history and pertinent bibliographical resources.

217. Aegean Art. A study of the problems of Aegean art as the forerunner of Greek art and in relation to the contemporary civilization of the eastern Mediterranean world. 2 units. Markman

218. Early Greek Art. A study of the problems of the origin and development of Greek art in the Geometric period to the end of the Archaic. 3 units. Markman

***233. Early Mediaeval Architecture.** The development of religious architecture from the time of Constantine to the end of the First Romanesque style in the third quarter of the eleventh century. 3 units. Sunderland

***234. Romanesque Sculpture.** The development of sculpture in Western Europe from the early Christian period through the culmination of Romanesque art in the west portal of Chartres Cathedral. 3 units. Sunderland

237. French Renaissance Art. Sixteenth century painting and sculpture in France with special emphasis on Italian influences. Prerequisites: some knowledge of Italian Renaissance art and the ability to read French; or consent of the instructor. 3 units. Jenkins

238. Sienese Painting. Painting in Siena in the late Middle Ages and the Renaissance. Open to majors in history of art or by consent of the instructor. 3 units. Jenkins

239. Seminar in Architecture of Britain. A summary of recent archaeological activity in the British Isles and a survey of medieval building, the course deals principally with changing architectural problems and their solutions from the advent of the Renaissance onward. Attention is given to the interests of students majoring in history or literature. Prerequisite: Art 61. 3 units. Hall

240. Seminar in Architecture of North America. A study illustrating the transplantation of European architectural customs since the sixteenth century; the time-lag in transit and acceptance of later European developments; the gradual assumption of confident independence in design; and the emergence of international leaders in the United States. Prerequisite: Art 61. 3 units. Hall

241. Problems in Latin American Art. The architecture, painting, sculpture, and other arts with the emphasis on colonial architecture of Central America. Open to students who have a reading knowledge of Spanish and/or have had courses in Latin American history, economics, or literature. 3 units. Markman

*Offered upon demand.

247. Problems in the History of Graphic Arts. Concentrated study of selected topics in the history of prints and drawings. 3 units. Mueller

248. Florentine Painting during the Renaissance. Prerequisite: Art 137 or 138 or consent of the instructor. 3 units. Covi

249. Problems in Pre-Columbian Art and Archaeology. Architecture, sculpture and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region. Prerequisite: Art 149, apposite courses in anthropology or Latin American history, or consent of instructor. 3 units. Markman

251-252. Research. A course designed to give instruction in methods used in the investigation of original problems. Open to seniors by permission of the Director of Undergraduate Studies. 6 units. Heckscher

253. Studies in Italian Renaissance Sculpture. Prerequisite: Art 137 or 138 or consent of instructor. 3 units. Covi

255, 256. Iconological Problems. Study of subject matter and sources. 3 units per semester. Langedijk

291, 292. Museology Seminar. Operation of a museum; instruction in exhibition and restoration techniques, as well as registration and the researching of art objects with a view to exhibition accompanied by scholarly catalogues. Open to art majors or by consent of the instructor. 3 units each semester. Heckscher and Staff

293, 294. Special Problems in Art History. Individual study and research. 3 units each semester. Staff

399. Directed Reading and Research. 1 to 3 units. Staff

Asian Languages

The course is offered as an enrichment for students interested in the South Asian subcontinent and may be taken as a general elective by advanced undergraduate students. No major work is offered in Hindi-Urdu.

Hindi-Urdu 200-201. Special Studies in South Asian Languages. Intensive concentration in advanced Hindi reading and conversation, or specialized graded work in cognate South Asian languages necessary for the advanced student contemplating field work in South Asia. Prerequisite: consent of instructor. 6 units. Staff

For offerings in Chinese and Japanese, see Bulletin of Undergraduate Instruction.

Biochemistry

Professor Hill, Chairman (Medical Sciences Building); Professor Gross, Director of the Genetics Division (Medical Sciences Building); Professor Kirshner, Director of Graduate Studies (Medical Sciences Building); Professors Fridovich, Guild, Handler,* Kamin, McCarty, and Tanford; Associate Professors Appel, Greene, Harris, Kaufman, Lynn, Rajagopalan, Sage, and Webster; Assistant Professors Bell, Habig, Hall, Harriman, Kelley, Kim, Kredich, Lefkowitz, McKee, Reynolds, Richardson, Siegel, Sullivan, and Wheat; Associates Bittikofer, Bonaventura, McCord, Nozaki, and Steinman

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcomed, but adequate preparation in chemistry is essential. Graduate specialization areas include protein structure and function, crystallo-

*On leave of absence.

graphy of macromolecules, nucleic acid structure and function, lipid biochemistry, membrane structure and function, molecular genetics, enzyme chemistry, and neurochemistry. The Division of Genetics of the department, in cooperation with the University Program in Genetics, offers biochemistry students the opportunity to pursue advanced research and study to fulfill the requirements for the Ph.D. degree.

204. Introductory Genetics. An introduction to genetic analysis with emphasis on the molecular basis of mutation, segregation, function, and organization of the genetic material. Primarily for medical students, but graduate students may be admitted with the instructor's permission. (Also listed under the University Program in Genetics.) 3 units. Gross and Others of the University Program in Genetics

208. Laboratory Methods in Biochemistry. An advanced laboratory course that emphasizes current procedures, instrumentation, and experiments. Each student selects from a number of experiments a wide range of classical investigations that illustrate significant biochemical progress. Prerequisites: Biochemistry 293, 295, and 297, or equivalent. Offered only in the summer. 2 units. Staff

209-210. Independent Study. A tutorial designed for students who are interested in either a laboratory or a library project in biochemistry. Units to be determined. Staff

216. Molecular Genetics. An advanced course on genetic mechanisms and their relationship to nucleic acids. Prerequisites: introductory courses in biochemistry and genetics or consent of instructor. (Also listed under the University Program in Genetics.) 3 units. Guild and Others of the University Program in Genetics

219. Molecular and Cellular Basis of Development. See course description for Anatomy 219. (Also listed as Anatomy 219, Microbiology 219, Pathology 219, and Physiology 230.)

219. Optional laboratory offered in conjunction with the lecture. Techniques of organ and cell culture, chromosome morphology, and some electron microscopy as applied to development and differentiation. 2 units. McCarty, Bolognesi, Harris, Johnson, and Kaufman

219S. Seminar. Optional seminar offered in conjunction with Biochemistry 219.

222. Structure of Biological Macromolecules. Introduction to the techniques of structure determination by X-ray crystallography and study of some biological macromolecules whose three-dimensional structures have been determined at high resolution. 2 units. Kim and Richardson

241. General Biochemistry. An introductory survey of fundamental aspects of biochemistry with emphasis on the structure of macromolecules, mechanism of enzyme action, metabolic pathways, biochemical genetics, and the structure and functions of special tissues. Designed for medical students. Graduate students, only with permission of instructor. 4 units. Hill and Staff

247. Introductory Biochemistry. The chemistry of proteins, lipids, carbohydrates, and nucleic acids and the metabolic interrelationships of these compounds. The biochemical basis of photosynthesis, genetics, vision, nutrition, nerve conduction, and muscle contraction will also be considered. Prerequisites: Chemistry 151, one year of college physics (second semester may be concurrent), Mathematics 22, or consent of the instructors. This course is acceptable in partial fulfillment of the departmental major re-

quirements in biochemistry, botany, chemistry, and zoology. (Listed also as Botany 248 and Zoology 248.) 3 units. Sage and Webster

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of genetic code, mutation and protein polymorphism, natural selection, and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of instructor. (Given at Beaufort.) 6 units. Sullivan

282. Experimental Genetics. A series of laboratory exercises and discussions on the molecular mechanisms of mutation, recombination, replication, transcription, and translation of the genetic material. May be taken concurrently with Genetics 280. Prerequisite: consent of instructor. (Also listed under the University Program in Genetics.) 2 units. Harriman and Others of the University Program in Genetics

284. Current Topics in Genetic Mechanisms. A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in response to adequate demand. Prerequisites: Genetics 280 or its equivalent and consent of the instructor. (Also listed under the University Program in Genetics.) 1 unit. Hall and Others of the University Program in Genetics

286. Current Topics in Immunochemistry. The structure, function and specificity of antibodies. Immunogenicity and tolerance with special emphasis on current theories of the diversity and synthesis of antibody molecules. 2 units. Sage

288. The Carbohydrates and Lipids of Biological Systems. The subjects will be considered in the following two general categories: (a) the relationship between chemical structure and biological function, and (b) biosynthesis and catabolism. 2 units. Kaufman

290. Bioenergetics. Biological mechanisms of transduction of energy (covalent, ionic, photonic, and electric) will be considered, using photosynthetic, oxidative, phosphorylative, and glycolytic systems as examples. Since many of the above processes occur in membranous systems, the role and function of membranes in these processes will also be considered. 2 units. Lynn

293. Macromolecules. The structures of biological macromolecules and their relations to biological functions. Prerequisites: physical chemistry equivalent to Chemistry 161-162. 4 units. Hill, Kim, Richardson, and Tanford

294. Nucleic Acids and Macromolecular Synthesis. The biological properties of nucleic acids and nucleoprotein interactions in terms of their physical and macromolecular structure. Emphasis on the control of transcription and translation of RNA in mammalian cells. These studies include gene amplification, post synthetic modifications of chromosomal proteins as a result of hormone induction. The effect of antibiotics on protein synthesis and polypeptide bond formation is considered in terms of initiation, decoding, translocation, ribosomes, termination, and release. 3 units. McCarty and Staff

295. Enzyme Mechanisms. A study of current views of the modes of action of enzymes and of the techniques which are found most useful in

elucidating these matters. Theory and practice will be given equal emphasis. 3 units. Fridovich and Rajagopalan

296. Biological Oxidations. A lecture, conference, and seminar course which deals with the mechanism of electron transport and energy conservation in a variety of oxidative enzymes. These mechanisms will be examined both in purified enzymes and in organized systems such as the mitochondrion, the endoplasmic reticulum, and the chloroplast. 2 units. Kamin, Fridovich, Rajagopalan, and Siegel

297. Intermediary Metabolism. The synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids will be discussed in detail with emphasis on energy transformation and metabolic interrelationships. 3 units. Kirshner and Siegel

298. Regulation of Cellular Metabolism. The metabolic, hormonal, and genetic parameters involved in regulation of the metabolic activities of the cell are surveyed with emphasis on patterns of regulation. Selected regulatory mechanisms are considered in detail. Prerequisites: Biochemistry 295 and 297 or permission of instructor. 2 units. Greene and Staff

299. Nutrition. This course examines the experimental basis for the identification and quantitation of requirements for calories, macronutrients, and micronutrients (vitamins and minerals); the biochemistry of nutrition with the assessment of nutriture; and the biological effects of deficiency or excess of nutrients. The course seeks to define optimal nutriture, and will search for factual bases for common beliefs on nutrition. Informal lectures and, if possible, student seminars. Prerequisite: a basic biochemistry course, its equivalent, or permission of instructor. 2 units. Kamin

302. Neurochemistry. The course will emphasize those aspects of structure, function, and metabolism unique to the nervous system—myelin, neurotubular and neurofilaments, axoplasmic flow, synthesis, storage and secretion of transmitters, properties and interactions of neuroreceptors, and nerve-muscle relationships. 3 units. Kirshner, Kaufman, Bell, Appel, and Vanaman

345, 346. Biochemistry Seminar. Required of all biochemistry students. 1 unit per semester. Siegel and Staff

351, 352. Genetics Seminar. Required of all students specializing in genetics. (Also listed under University Program in Genetics.) 1 unit per semester. Harriman and Others of the University Program in Genetics

390. Biochemistry of Membranes. Physical and chemical properties of biological membranes. Properties of constituent lipids and proteins in relation to membrane function. Prerequisite: Biochemistry 293 or its equivalent. 2 units. Reynolds, Tanford, and Bell

395. Biochemical Pharmacology. (For description, see Physiology and Pharmacology 395.) 2 units.

Botany

Professor Wilbur, Chairman (149 Biological Sciences Building); Professor Johnson, Director of Graduate Studies (354 Biological Sciences); Professors Anderson, Billings, W. Culberson, Hellmers, Kramer, Naylor, Philpott, Stone, and White; Associate Professors Antonovics, Barber, Boynton, Knoerr, Searles, and Strain; Assistant Professors Blankley and Christensen; Lecturer C. Culberson

Graduate work in the Department of Botany is offered leading to the A.M.

and Ph.D. degrees. Before undertaking graduate study in botany a student should have had in his undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. Graduate Record Examination scores are required of all applicants. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

203. Cytogenetics. Organization and variation of chromosomes in relation to genetics and evolution. Meiotic behavior and variations, chromosomal rearrangements, polyploidy, karyotype evolution, and mechanisms of chromosomal changes. Prerequisite: one year of biology. Laboratory optional, but limited to 12 students. 3 units. Anderson

203L. Laboratory in Cytogenetics. Techniques for chromosomal preparations for light microscopy. Mitotic and meiotic interpretations, determination of chromosome numbers and karyotypic comparisons. Ordinarily to accompany Botany 203. 1 unit. Anderson

204. Introductory Marine Microbiology. The biology of microorganisms in oceans and estuaries. Prerequisite: one year of college biological science. (Summer session only.) 6 units. Blankley

205. Anatomy. Intensive survey of vascular plant cell types, tissues, and organs, with emphasis on the modern application of anatomy to problems of systematics and phylogeny. Laboratories will include microtechnique. Special project and term paper stressing current techniques and literature required. Prerequisite: permission of instructor. 4 units. White

206. Anatomy of Woody Plants. Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations and for study of micro and ultrastructures with light and electron microscopy. Relationship of micro structures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. (Also listed as Forestry 206.) 4 units. Philpott

209. Lichenology. Morphology, systematics, and biological and ecological implications of the lichens. Collection and identification of specimens and the use of lichen chemistry in taxonomy. 3 units. W. Culberson and C. Culberson

210. Bryology. Morphological, systematic, and ecological characteristics of mosses and liverworts. 3 units. Anderson

211. Marine Phycology. An introduction to marine algae: their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. (Summer session only.) 6 units. Searles

212. Phycology. Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. 4 units. Searles

221. Mycology. Field and laboratory study of the vegetative and reproductive structures of the fungi and slime molds. Methods of collection, isolation, propagation, and identification of the major orders as represented in the local flora. Prerequisite: one year of biological science. 4 units. Johnson

225, 226. Special Problems. Students with adequate training may do special work in the following fields. Credit to be arranged. 1-4 units.

1. Cytology; Bryology. Anderson
2. Genetics. Antonovics
3. Ecology. Billings
4. Phycology. Blonkley
5. Genetics. Boynton
6. Ecology. Christensen
7. Lichenology. Culberson
8. Physiology. Hellmers
9. Bacteriology; Mycology. Johnson
10. Physiology. Naylor
11. Anatomy and Morphology of Vascular Plants. Philpott
12. Phycology. Seorles
13. Systematics of Flowering Plants. Stone
14. Ecology. Strain
15. Anatomy and Morphology of Vascular Plants. White
16. Systematics and Taxonomy of Vascular Plants. Wilbur

236. Major Global Ecosystems. Study of a single global ecosystem such as arctic-alpine, desert, tropical rainforest, grassland, or coniferous forest, including the place and effects of primitive and modern man. 3 units. Billings

242. Systematics. A general survey of the principles of vascular plant taxonomy, with practice in identification and collection. Lectures, laboratories, and field trips. Prerequisite: one year of biology. 4 units. Wilbur

245. Plant Diversity. An examination of the major groups of the living plants and a consideration of their evolutionary origins and phylogenetic relationships. 4 units. Culberson and White

246. Ecology. Intensive study of the environmental effects on growth and distribution of plants at the level of the individual, the population, and the ecosystem. A term paper will be required. Lectures, laboratories, and field trips. Prerequisite: permission of instructor. 4 units. Billings or Strain

248. Introductory Biochemistry. (See course description for Biochemistry 247.) (Also listed as Biochemistry 247 and Zoology 248.) 3 units. Sage

250. Plant Biosystematics. Descriptive and experimental procedures in vascular plant evolution. Discussions on laboratory and field-oriented problems. Prerequisites: basic courses in systematics and genetics. 4 units. Stone

251. Physiology. Physiological processes in plants and their interrelationships. Lectures, laboratories, and readings. Prerequisite: permission of instructor. 4 units. Hellmers

252. Plant Metabolism. The physiochemical processes and conditions underlying the physiological processes of plants. Prerequisite: Botany 151 or equivalent; organic chemistry is recommended. 4 units. Naylor

254. Plant-Water Relations. A study of factors affecting the availability of water, its absorption and movement through plants, and the effects of water deficits on plant processes. Prerequisite: Botany 151 or equivalent. 3 units. Kramer

255. Plant Systematics. A survey of the principles of plant taxonomy. Prerequisite: Botany 52 or equivalent. 4 units. Wilbur

257. Principles of Plant Distribution. Interpretation of floristic and ecological plant geography. Prerequisite: Botany 156 or equivalent. 3 units. Billings

258. Physiology of Growth and Development. Consideration of the internal factors and processes leading to the production of new protoplasm and its differentiation at the cellular, tissue, and organ level in plants. Prereq-

uisites: Botany 151 or equivalent; organic chemistry is recommended. 4 units. Naylor

259. The Environment. Environmental principles; methods of obtaining and evaluating environmental data for ecological purposes with special attention to instrumentation and microclimate. Prerequisite: Botany 156 or equivalent. 3 units. Billings

265. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisites: Botany 151 and 156 or equivalents. 4 units. Strain

265. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisites: Botany 151 and 156 or equivalents. 4 units. Strain

266. Analysis and Classification of Vegetation. The concepts and methods of synecology; modern approaches with a review of historical aspects. Prerequisite: Botany 156 or equivalent. 4 units. Christensen

280. Principles of Genetics. Introduction to the structure and properties of genes and chromosomes and to the evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics or equivalent. (Also listed as Zoology 280 and under the University Program in Genetics.) 3 units. Antonovics, Boynton, and Gillham

285. Population Genetics. (For a description of the course see the University Program in Genetics.) 2 units. Antonovics and Staff

286. Evolution. (Also listed as Zoology 286 and under the University Program in Genetics.) 3 units. Antonovics, Lundberg (Zoology), and H. Wilbur (Zoology)

359-360. Research in Botany. Individual investigation in the various fields of botany. Credits to be arranged. All Members of the Graduate Staff

The University Program in Genetics. Genetics courses offered by the Botany Department are an integral part of this interdepartmental program. Refer to the announcement in this Bulletin under the University Program in Genetics for description of the offerings.

204, Introductory Genetics; 215, Bacteriophage: Structure and Function; 216, Molecular Genetics; 236, Human Genetics; 280, Principles of Genetics; 282, Experimental Genetics; 284, Current Topics in Genetic Mechanisms; 285, Population Genetics; 336, Immunogenetics; 351-352, Genetics Seminar.

Program in Tropical Biology. Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section Organization for Tropical Studies in this Bulletin in the chapter Special and Cooperative Programs.

The University Program in Marine Sciences. Interdisciplinary programs emphasizing marine botany are available. Refer to the announcement in this Bulletin under Marine Sciences—The University Program.

Business Administration

Professors Baligh, Keller, Laughhunn, and Peterson; Associate Professors Baker, Battle, Burton, and Dellinger; Assistant Professors Aldrich, Damon, Kuhn, Maier, Petersen, Vander Weide, and Zalkind

The Graduate School of Business Administration offers work leading to the M.B.A., Ph.D., and the M.S. in Management Sciences. The M.B.A. program is designed for students whose undergraduate work included at least one year of calculus and an educational background adequate for rigorous

analysis. Normally, undergraduate majors in such fields as the physical and biological sciences, mathematics, engineering, and the social sciences are well suited for the program. The M.B.A. program is designed to provide a thorough foundation in the concepts and theory that underlie the design, operation, and control of modern complex organizations.

The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The doctoral level course work presumes either a Duke M.B.A. or the equivalent.

For information on the M.S. in Management Sciences, see page 87.

All 200-level courses in the Department of Management Sciences are open to graduate students from other departments. They are listed in the Bulletin of Undergraduate Instruction.

MASTER OF BUSINESS ADMINISTRATION

First Year Courses (Required)

300-301. Managerial Theory of the Firm. Classical economic theory and its further developments into more advanced, modern, and useful forms as elements of the fundamental theory of the firm are the subjects of this course. Major emphasis is on the theory of competitive price and non-price market behavior in single and multiple market segments, inventory and production planning, capital investment decisions, introductory concepts of co-operation for exchange (i.e., vertical production and marketing relationships), and formulation of the basic economic strategy of the firm. 5 units semester I and 4 units semester II.

310. Foundations for Quantitative Analysis I. Considers mathematical structures which are useful models for subsystems of an economic enterprise. The structures considered provide the framework for understanding and analyzing complex organizations and economic events, and develop problem-solving tools and techniques. This course provides the mathematical and statistical background beyond beginning calculus required in the M.B.A. program. Major topics are: sets, relations, and functions; introductory probability theory; linear algebra; classical optimization techniques; and introduction to linear programming. 5 units.

311. Foundations for Quantitative Analysis II. Continuation of B.A. 310. The major topics are: probability, statistical decision theory, sampling theory, estimation and hypothesis testing, and regression and correlation analysis. 4 units.

320. Management of Information and Control Systems I. The financial accounting model is developed as a critical subset of the general information system of the firm. This initial model is extended through consideration of general systems theory to encompass the economic and organizational models of the firm developed in B.A. 300 and 330. 3 units.

321. Management of Information and Control Systems II. The classical cost accounting model is developed and then restructured to provide data for planning and control of complex enterprises through use of modern managerial technology. This includes design of an information system that provides the data needed for advanced economic and organizational models of the firm. 3 units.

330, 331. Organization Theory and Management. The first semester of this course is concerned with the analysis of purposive behavior in complex organizations. Theories of individual decision-making, human aspects of groups, and normative and descriptive systems are the major areas of con-

cern. The second semester continues the work but emphasizes the firm as a social-political system. Strategy concepts, motives for collective activity, goal setting, and policy formulation are the primary topics. The course ends with an overview of the executive function within the administrative system. The purpose of the course is to provide the future administrator with an understanding of human behavior in groups and formal organizations particularly as that behavior deviates from and extends Business Administration 300-301. In addition, the course provides the behavioral theories and findings necessary for treating the firm as an information-processing, problem-solving system in Business Administration 320-321. 3 units per semester.

341. Macroeconomic Analysis. The economic theory pertaining to the economy of the nation is developed in this course. The determinants of price level, rate of growth, and level of aggregate income, employment, and output are studied with emphasis on understanding the rationale of government policies and the impact of governmental behavior on these variables. 2 units semester II.

Second Year Courses—Fall Semester (Required)

The purpose of the work in the third semester of the M.B.A. program is to provide advanced tools of analysis and a general framework of understanding within which those tools can be applied. The relationships among the parts of the firm and the relationships between the firm and the various sectors of its environment can be classified into those which are competitive and those which are cooperative. (Obviously, the relationships between any two organizations are likely to contain both competitive and cooperative aspects.) The work in this semester is focused on more advanced analysis of how the firm's internal relationships and actions are related to the firm's external relations and actions. Since the legal framework is closely related to these matters, an introduction to some aspects of the law is included. Prerequisites for this set of courses are the courses in the first-year M.B.A. program.

302. Cooperative Decisions and Competitive Strategies. Problems of choosing cooperative economic relations in order to effect exchange transactions, and the problems of determining competitive behavior. The efficiency and stability of various forms of cooperative vertical market structures under simple competitive conditions are rigorously studied. Competitive market decisions are studied in the context of the formulation and solution of purely competitive market games. Although the more advanced and rigorous portions of the course are mathematical and theoretical, increasing emphasis is focused on the practical applications to markets and the development of realistic combinations of cooperative and competitive programs. 4 units.

303. Cooperative-Competitive Relations and Decisions. The firm's decisions on its cooperative and competitive behavior and on the design of its internal structure and its production and financial operations are treated simultaneously in the models of this course. The subject of the course is the firm's coordinated treatment of the decision variables which reflect its direct relations to those economic units with which it cooperates and competes to effect exchange transactions, and those which relate to the form of its internal operations and organizational structures. 2 units.

312. Operations Research. Mathematical models of various aspects of economic operations are developed and solved, including topics in the areas of queuing, inventory, and maintenance. General procedures for the solution of mathematical problems involving the identification of maxima

and minima are studied along with simulation and the use of the computer for the generation of solutions. 4 units.

332. Organization Design and Internal Operations. The design organizations for coordination and control of the internal operation is studied. The topics include: (a) specialization, both functional and hierarchical, with particular attention to the problems of decomposition and decentralization; (b) coordination, including benefit/cost analyses of alternative means of coordination; and (c) control, with emphasis on the role of information systems and the design of decision rules. These topics are examined for the organization in general, but with specific references and application to the production and finance segments. 4 units.

349. Law as a Constraint for Business. The major laws that specify the rules within which the firm must operate, including some aspects of the commercial code, anti-trust law, labor and fair employment law, the most significant regulatory agencies, and court cases that assist in understanding the application and interpretation of the law are studied. 2 units.

Second Year Courses—Spring Semester

This final semester of the M.B.A. program is oriented to bring to application the foundations built during the first three semesters. Hence, the bulk of the work in this semester is directed toward understanding and solving problems of the firm, using the tools of analysis and the conceptual framework developed earlier. The only specifically required courses are Business Administration 350 and 390.

350. Public Policy of the Firm. This course is focused on analysis of the relationships between the firm and the three segments of society: the public at large, the organizations and individuals in close contact with the firm, and the members or employees of the firm. Primary emphasis of the other parts of the M.B.A. program is on design and decision-oriented to reach the goals of the firm. This course treats some of the problems involved in selecting the ends and restraints from among feasible alternatives: i.e., the problems of developing a policy of the firm toward the society of which it is a part. 3 units.

390. The Practicum. The practicum is individually designed and is a major component of the second-year program designed to give the student a significant experience in applying the concepts, theories, and methods of analysis he learns in the program to a real, complex problem of an economic enterprise. It should include the analysis of the real situation and the explicit formulation of the problem. That is, the problem which the student treats in the practicum should not be described with only the solution left to be developed. The important task of identifying and specifying the actual problem, perhaps after being directed to correct some undesirable symptoms, is an integral part of the practicum.

The practicum report should propose a solution to the problem specified and should contain the explanation and logic that supports those recommendations. This solution should be one that can be implemented and must not ask for human or nonhuman resources unavailable for use in the proposed solution. Further, where the solution of the problem is sensitive to the assumptions made, those assumptions must be realistic. The practicum is supervised by one of the two professors teaching the electives selected by the student. 5 units.

313. Advanced Operations Research. Emphasis on application of dynamic and stochastic models and less on static and deterministic models and on the strategic design and control of more complex, multi-unit activities

leads to formulation of operations research models and modification of existing models for new and novel problem situations. 4 units.

323. Controllership. The focus of this course is on developing systems for collecting and summarizing data in a manner which meets the requirements of the management team in its function of controlling and planning operations of the firm. The function of the controller, as the center for synthesis and analysis of data, is studied in the context of the foundations established during the first three semesters of the program. 4 units.

324. External Reporting and Auditing. This course builds on the information systems sequence of the first year and the public policy course, Business Administration 350, in terms of developing requirements of the system for reporting to parties, external to the firm, who have need for information about the activities of the enterprise for decision-making purposes. Communication and measurement problems as well as the role of the independent auditor in developing evidence of and attesting to the reliability of data will be studied in detail. 4 units.

333. Manpower Planning and Management. An application of behavioral and economic theories and of quantitative techniques to management of the firm's human resources, including treatment of both labor and management personnel. Detailed examination of American occupational structure (e.g., mobility patterns, increasing specialization, and professionalization) and analysis of the labor union as an institution are included. Topics studied within the constraints of industrial and labor institutional structure are: employee testing, selection and assignment, training and development, performance evaluation and optimal incentive systems, and strategic and tactical factors in collective bargaining. 4 units.

351. Finance. The management of the financial affairs of the firm in its attempt to develop an optimal capital structure includes the sale of corporate securities of all varieties and the related knowledge about the requirements of investors at particular points in time, and the translation of plans and programs into needs which must in turn be met by cash resources from either internal or external sources. 4 units.

353. Marketing. An application of the general theories previously studied to the firm's marketing problems. Definition and resolution of these problems involves a more detailed discussion of the existing market environment of the firm. Problems studied are those of consumer behavior, marketing structures, product planning, pricing, promotion, logistics, and marketing research. 4 units.

355. Production. The purpose is to give the student experience in applying the theories developed during the first three semesters to problems of professional practice in the area of production management. Two major problem areas are covered: the design (or planning) of manufacturing systems and their operation (or control). Sub-topics under design include plant layout, economic evaluation of materials, methods, and processes and facilities planning. Sub-topics under operation include cost, inventory, quality control, short-run scheduling and capacity utilization, maintenance, start-up problems, and equipment replacement. 4 units.

DOCTOR OF PHILOSOPHY

One year of study (30 units) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should include two courses in advanced economic theory, two courses in mathematics or statistics, one course in philosophy of science, and three courses in an elected field of administration. The latter are individually

designed and are offered on a tutorial basis to provide extensive reading in the historical and current literature, and a demanding research program.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

309.1-.9. Research in Managerial Economics. 1 to 6 units.

319.1-.9. Research in Quantitative Methods. 1 to 6 units.

329.1-.9. Research in Information and Accounting Systems. 1 to 6 units.

339.1-.9. Research in Organization Theory and Management. 1 to 6 units.

348.1-.9. Research in Public Policy and Social Responsibility. 1 to 6 units.

352.1-.9. Research in Finance. 1 to 6 units.

354.1-.9. Research in Marketing. 1 to 6 units.

356.1-.9. Research in Production. 1 to 6 units.

391.1-.3. Supervised Independent Research. This is to allow students in the M.B.A. program who are judged not to need required courses to do more advanced work. 1 to 5 units.

392-393. Tutorial in Interdisciplinary Areas. 1 to 6 units.

397. Dissertation Research. 1 to 6 units.

MASTER OF SCIENCE IN MANAGEMENT SCIENCES

300. Managerial Economics. Development of the fundamental theory of economic enterprise and use of that foundation in the analysis of economic operations. Theories of production, demand, and market behavior are developed to examine transformation and transaction operations of the firm. Emphasis is on optimum solutions to problems of internal efficiency and on design of cooperative and competitive strategies for the economic enterprise. 4 units.

302. Planning and Internal Organization. Short-run planning with emphasis on linear economic models and long-run planning with emphasis on capital budgeting models. Design of internal structure and management information systems for planning, implementation, and control. 4 units.

310. Mathematics for Management. Mathematics for optimization with and without constraints in linear and nonlinear systems. Topics include partial derivatives, Lagrange multiplier, Kuhn-Tucker conditions, matrix algebra, and linear programming. 4 units.

311. Probability and Statistics. Foundations of probability theory and statistical decision theory. Topics include: events, random variables, distributions, expectation, independence, functions of random variables, Central Limit Theorem, Bayes Law, elementary utility theory, sequential decision problems, use of experiments in decision problems, and an introduction to classical statistical inference. 4 units.

312. Operations Research. The development of quantitative models for analysis of management decision problems. Topics include postoptimality analysis of linear programming, network analysis, game theory, dynamic optimization models, and queuing theory. Several of these techniques are applied to the analysis of inventory problems. 4 units.

320. Organization Analysis and Operation Design. Analysis of organizations, emphasizing functional operations and design of the organization structure. Topics include determination of organization structure, the mech-

anisms of coordination, the requirements of information, the design and use of decision rules, the choice of a partitioning scheme for the organization, the mechanisms of control, and the interaction among them. 4 units.

330. Accounting and Control Systems. Use of accounting data for planning, evaluating, and controlling activities of the enterprise. Special consideration is devoted to the requirements for data in the models and methods useful in modern forecasting, planning, and control. 4 units.

340. Controllership. The need for control and effective ways to provide it, primarily through budgetary processes. Special attention is devoted to project evaluation, control reports, and analysis of the variance between planned results and actual results. 4 units.

341. Marketing Management. Analysis of the firm's general market competitive and cooperative strategy problem. Specific problem areas include pricing, product and product line design, promotion, logistics, and research, and the relationships among these various problem areas and their solutions. 4 units.

342. Financial Management. Sources and uses of financial resources for the firm are examined. Capital budgeting, cash management, and the mix of external financing are examined in the context of attempts to achieve the optimal capital structure of the firm. 4 units.

343. Production Management. Design of manufacturing systems, operating rules, and policies. Included are: choice of technology, design of the physical system, development of operating procedures and decision rules for scheduling, inventory and cost control, quality assurance, and the interaction of manufacturing with other functions of the firm. 4 units.

344. Human Resource Management. The design of plans and policies for effective and efficient management of the firm's human resources. Emphasis is placed on the development of policies for training, selection, compensation, and career planning which are consistent with the overall mission of the firm and with the firm's production, marketing, and financial policies. Some attention is devoted to discussion of the possible conflicts and trade-offs between corporate objectives and the welfare of individual members of the firm. 4 units.

350. Social Issues and the Complex Organization. Examination of issues that arise because market competition does not produce the effects demanded by society. Areas considered include: regulation of competitive activities, buyer protection, fair employment and labor relations, environmental protection, and social incentive for economic action. The effect of "self-regulation" and of "governmental regulation" are compared. 4 units.

390. Practicum. A major project in which the student selects a problem of an economic organization and develops its solution. Normally the problem is from the organization of which he is a part, and the problem is a specific case of the general area represented in the elective selected for concurrent registration. 4 units.

Chemistry

Professor Quin, Chairman (101 Gross Chemical Laboratory); Professor Chestnut, Director of Graduate Studies (329 Gross Chemical Laboratory); Professors Bradsher, Hobbs, Jeffs, Krigbaum, McPhail, Parham, Poirier, Smith, Strobel, Wells, and Wilder; Associate Professors Henkens and Palmer; As-

sistant Professors Baier, Baldwin, Crumbliss, Gutknecht, Lochmüller, and Porter; Adjunct Professor Peterlin; Adjunct Associate Professors Ghirardelli, Pitt, Rosenthal, and Spielvogel

In the Department of Chemistry graduate work is offered leading to the A.M. and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry, along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields.

A booklet providing detailed information on the department is available from the Director of Graduate Studies.

For Seniors and Graduates

201. Molecular Spectroscopy. Selected spectroscopic methods in the study of molecular structure. Topics include symmetry and group theoretical basis for selection rules, theories of magnetic and optical resonance, and interpretation of spectra, with examples drawn from both inorganic and organic chemistry. 3 units. Staff

203. Quantum Chemistry. Basic principles of quantum and group theoretical methods. Topics include symmetry, a review of the fundamentals and the mathematical foundations of quantum theory. A major emphasis is placed on the application of molecular orbital theory to organic and inorganic systems. 3 units. Staff

205. Structure and Reaction Dynamics. Structure and mechanisms in organic and inorganic compounds, substitution reactions, linear free energy relations, and molecular rearrangements. Particular emphasis is placed on the use of kinetic techniques to solve problems in reaction mechanisms. 3 units. Staff

207. Principles of Thermodynamics, Diffraction, and Kinetics. Basic principles with applications to important chemical problems. 3 units. Staff

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry (Chemistry 160 and 162 or equivalent), statistics (Mathematics 183 or equivalent), or permission of the instructor. (Given at Beaufort.) Includes lectures, laboratory work, and field trips. (Also listed as Marine Sciences 240.) 6 units. Baier

For Graduates

300. Basic Statistical Mechanics. Fundamentals of quantum and classical statistical mechanics using the ensemble approach. Emphasis on systems of weakly interacting particles with internal degrees of freedom. 3 units. Staff

302. Basic Quantum Mechanics. The fundamentals of quantum mechanics with special emphasis on chemical applications. Topics included are: linear algebra, the uncertainty relations, angular momentum, perturbation theory and time dependent phenomena, molecules in electromagnetic fields, group methods, and electron correlation. 3 units. Staff

303, 304. Special Topics in Physical Chemistry. Presentation of one or more topics of staff interest such as advanced methods in crystallography, light scattering and small angle X-ray diffraction, application of ESR spectroscopy to chemical problems, electronic spectroscopy of proteins, group theory, intermolecular forces, liquid crystals, methods of determining the rates of elementary steps in reaction kinetics, physical chemistry of aero-

sols, physical-chemical methods of polymer characterization, structure and bonding in metalloenzymes, statistical mechanics of fluids, topics in structural chemistry, and triplet excitons. 1 to 3 units per semester. Staff

310. Theoretical and Structural Inorganic Chemistry. An advanced study of theoretical concepts and structural determination techniques as applied to inorganic systems. Areas included are crystal field and ligand field theories, magnetic susceptibility, and electronic, infrared, and Raman spectroscopy. 3 units. Crumbliss and Palmer

312. Inorganic Reactions and Mechanisms. Chemistry of main group and transition elements. Emphasis on current developments in synthetic and mechanistic studies of inorganic, organometallic, and organometalloid compounds. 3 units. Crumbliss and Wells

313, 314. Special Topics in Inorganic Chemistry. Lectures, oral reports, and discussions on advanced topics and recent advances in the field of inorganic chemistry. Examples of topics which may be discussed are bioinorganic chemistry, fluxional molecules, homogeneous catalysis, synthesis and properties of selected groups of compounds, and new physical methods. 1 to 3 units per semester. Staff

320. Synthetic Organic Chemistry. A study of the scope and limitations of the more important types of reactions in synthetic organic chemistry. Some discussion of the rapidly developing use of transition metals, complex hydrides, and photochemistry will be included. 3 units. Baldwin, Bradsher, and Parham

322. Organic Reactive Intermediates. A discussion of reactive intermediates in organic chemistry. Topics will include carbanions, carbenes, carbonium ions, free radicals, photochemical excited states, and other reactive species. 3 units. Porter and Wilder

323, 324. Special Topics in Organic Chemistry. Advanced topics and recent developments in the field of organic chemistry. Each year heterocyclic chemistry or the chemistry of natural products will be among the topics presented. Lectures, and written and oral reports. 1 to 3 units per semester. Staff

330. Chemical Separation Methods and Kinetics in Analytical Chemistry. The principles of rate processes and diffusion; plate-theory, adsorption and chemical selectivity. Thermodynamics of processes leading to differential migration in chromatography. Kinetic methods of analysis with emphasis on the quantitative determination of concentration in biological and non-biological systems. 3 units. Staff

331, 332. Special Topics in Analytical Chemistry. An advanced treatment of important areas in modern analysis. Possible topics include: electrochemistry, small computer applications, magnetic resonance, and problem-solving approaches. 1 to 3 units per semester. Staff

334. Chemical Instrumentation and Applied Spectroscopy. Principles of instrumental design. Topics covered include input transducers, dispersive devices, servo systems, operational amplifiers, and digital logic. An introduction to advanced topics in analytical spectroscopy. Fourier transform methods in infrared and n.m.r. spectroscopy, X-ray fluorescence, applications of lasers to high-speed measurements, and fast-scan spectrophotometry. 3 units. Staff

373, 374. Seminar. Required of all graduate students in chemistry. One hour a week discussion. 1 unit per semester. All Members of the Graduate Staff

375, 376. Research. The aim of this course is to give instruction in methods used in the investigation of original problems. Individual work and conferences. 1 to 6 units. All Members of the Graduate Staff

377. Research Orientation Seminar. A survey of departmental research. Required of all entering graduate students in chemistry. Prerequisite: permission of the Director of Graduate Studies. 1 unit. All Members of the Graduate Staff

Classical Studies

Professor Oates, Chairman, (325 Carr); Professor Newton, Director of Graduate Studies (326 Carr); Professors Richardson, Truesdale, and Willis; Associate Professor Stanley; Assistant Professors Burian, Nixon, and Rigsby; Visiting Lecturer Levy

The Department of Classical Studies offers two programs leading to the Ph.D. degree, one with emphasis on literature and philology, the other with emphasis on ancient history and archaeology. For regular admission to the program in literature and philology, a student must offer three years of college study above the elementary level in one of the classical languages and two college years in the other. Students wishing to enter the program in ancient history and archaeology will be required on entrance to demonstrate satisfactory competence in both Greek and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficiency.

The department's special requirements in addition to the general requirements of the University for the Ph.D. degree set forth in the section on Program Information of this Bulletin are presented in a sheet that may be obtained from the Director of Graduate Studies. They include special requirements in seminars, course work, and the preliminary examination for the Ph.D. degree.

A reading knowledge of German and French is required of all candidates for the Ph.D. degree. The candidate should meet one of the language requirements by the end of his first term in residence and the other by the end of his third term.

GREEK

For Seniors and Graduates

200. Graduate Reading. 3 units. Truesdale

***203. Homer.** The *Iliad* and *Odyssey*; The problem of language and structure in the epic; present state of Homeric scholarship. 3 units. Stanley

205. Greek Lyric Poets. Fragments of the early lyric poets; selected odes of Pindar and Bacchylides. 3 units. Truesdale

***206. Aeschylus.** The *Oresteia*, with study of the form of Agamemnon and its place in the design of the trilogy. 3 units. Willis

208. Sophocles. The Theban plays; the structure and style of Sophoclean tragedy. 3 units. Willis

***209. Euripides.** Representative tragedies in their political and philosophical context; analysis of dramatic form and texture. 3 units. Stanley

***210. Aristophanes.** Origin and development of Greek comedy; representative plays of Aristophanes. 3 units. Truesdale

*Not offered in 1974-75.

*221. **Early Greek Prose.** Greek prose in the fifth century from the Ionian scientists and logographers to Herodotus, Gorgias, Antiphon, and the Old Oligarch. 3 units. Truesdale

*222. **Thucydides.** The History; Thucydides' historical method and style. 3 units. Willis

*223. **Greek Orators I.** Early fourth century rhetoric, including Andocides, Lysias, and Isocrates. 3 units. Willis

*224. **Greek Orators II.** Aeschines' Against Ctesiphon and Demosthenes' On the Crown in the light of fourth century political history and rhetorical development. 3 units. Willis

*225. **Plato.** Selected dialogues and related passages illustrating the development of philosophical topics and stylistic motifs. 3 units. Burian

*231. **Hellenistic Poetry.** The principal lyric, elegiac, pastoral, and didactic poets of Alexandria; emphasis on Callimachus and Theocritus. 3 units. Stanley

241. **Advanced Prose Composition.** Xenophon, Lysias, and other prose authors as models of style and practice in the writing of Attic prose. 1 unit. Willis

For Graduates

(At least two of these are offered each year.)

301. **Greek Seminar I.** 3 units.

302. **Greek Seminar II.** 3 units.

303. **Greek Seminar III.** 3 units.

304. **Greek Seminar IV.** 3 units.

305. **Greek Seminar V.** 3 units. Stanley

306. **Greek Seminar VI.** 3 units. Oates

311. **Proseminar in Papyrology.** 3 units. Willis

313. **Proseminar in Greek Epigraphy.** 3 units. Willis

321. **Seminar in Literary Papyri.** 3 units. Willis

323. **Seminar in Documentary Papyri.** 3 units. Oates

399. **Directed Reading and Research.** Variable credit. Stanley

LATIN

For Seniors and Graduates

200. **Graduate Reading.** 3 units. Newton

201. **The Verse Treatise.** The genre of didactic poetry; emphasis on Lucretius' De Rerum Natura, Vergil's Georgics, and Ovid's Ars Amatoria; attention to Cicero's Aratea, the Astronomica of Manilius, Horace's Ars Poetica, and Ovid's Fasti. 3 units. Newton

202. **Roman Satire.** A survey of the genre, with concentration on Horace, Juvenal, and Persius. 3 units.

*203. **Epic: Vergil.** The Aeneid. 3 units. Newton

204. **Epic: Lucan and Statius.** The development of the Roman epic in the Silver Age. 3 units. Richardson

*207. **The Prose Epistle.** The letter as a vehicle of communication and as a literary form. 3 units. Richardson

*Not offered in 1974-75.

***208. The Epistle In Verse.** The verse letter as a literary form; reading in the Epistles of Horace, the Heroides of Ovid, and Statius. 3 units.

***209. Fragments of Early Latin.** The remains of Latin poetry of the third and second centuries B.C.; from Livius Andronicus to Lucilius, with emphasis on the epic and drama of Ennius. 3 units. Stanley

***210. Lyric and Occasional Poetry.** Shorter verse forms; epigram, pastoral, song, and panegyric. 3 units.

***211. Roman Oratory I.** The literary history and criticism of Roman oratory. 3 units. Richardson

***212. Roman Oratory II.** A continuation of Latin 211. 3 units.

***221. Mediaeval Latin I.** Latin literature of late antiquity, from Prudentius to the Carolingian Revival. 3 units. Newton

***222. Mediaeval Latin II.** Literature in Latin from Charlemagne to the Renaissance. 3 units. Newton

***225. Palaeography.** Latin book hands from the Roman Empire to the Italian Renaissance. 3 units. Newton

***241. Advanced Latin Composition.** Experiments in imitation of the great Latin prose styles and introduction to the composition of verse. 1 unit. Richardson

For Graduates

(At least two of these are offered each year.)

301. Latin Seminar I. 3 units.

302. Latin Seminar II. 3 units.

303. Latin Seminar III. 3 units.

304. Latin Seminar IV. 3 units.

305. Latin Seminar V. 3 units. Newton

306. Latin Seminar VI. 3 units. Newton

312. Proseminar in Latin Palaeography. 3 units. Newton

314. Proseminar in Latin Epigraphy. 3 units.

315. Proseminar in Roman Law. 3 units.

399. Directed Reading and Research. Variable credit. Newton

CLASSICAL STUDIES

For Graduates

301. Introduction to Classical Philology. Introduction to the bibliography and principal disciplines of the field. 3 units. Willis and Graduate Staff

CLASSICAL STUDIES (ANCIENT HISTORY)

For Seniors and Graduates

***253. Greece to the Orientalizing Period.** 3 units. Rigsby

***254. The Age of the Tyrants and the Persian Wars.** 3 units. Oates

***255. The Age of Pericles.** 3 units. Oates

***256. The Fourth Century through Alexander.** 3 units. Oates

*Not offered in 1974-75.

*257. Social and Cultural History of the Hellenistic World from Alexander to Augustus.

*258. Social and Cultural History of the Graeco-Roman World.

*260. The History of Rome to 146 B.C. 3 units. Staff

*261. The Roman Revolution, 146-30 B.C. 3 units. Oates

*262. Rome under the Julio-Claudians. 3 units. Nixon

*263. From the Flavian Dynasty to the Severan. 3 units. Nixon

*264. From Septimius Severus to Constantine. 3 units. Staff

*270. The Rise of the Hellenistic Kingdoms. 3 units. Oates

*271. The Hellenistic Kingdoms 250-31 B.C. 3 units. Oates

For Graduates

(At least two of these are offered each year.)

321. Seminar in Ancient History I. 3 units.

322. Seminar in Ancient History II. 3 units.

323. Seminar in Ancient History III. 3 units.

324. Seminar in Ancient History IV. 3 units.

325. Seminar in Ancient History V. 3 units. Oates

326. Seminar in Ancient History VI. 3 units. Oates

327. Seminar in Byzantine History. 3 units. Rigsby

399. Directed Reading and Research. Variable credit. Nixon

CLASSICAL STUDIES (ARCHAEOLOGY)

For Seniors and Graduates

*231. Greek Sculpture. Techniques and styles of the major schools and personalities in archaic, classical, and Hellenistic free-standing and architectural sculpture. 3 units. Stanley

*232. Greek Painting. Techniques and style in the various media; emphasis on the problems of chronology, attribution, and iconography of Attic pottery. 3 units. Stanley

*235. Roman Architecture. Significant monuments chosen to exemplify the Roman genius in building in the late Republic and early empire. 3 units. Richardson

*236. Roman Painting. Roman pictorial art with concentration on the wall-paintings from Campania. Investigation of techniques, iconography, and the use of pictures in decoration. 3 units. Richardson

For Graduates

(One course is offered each year.)

311. Archaeology Seminar I. 3 units. Stanley

312. Archaeology Seminar II. 3 units.

Under the terms of a cooperative agreement, graduate students of Duke University may, with the approval of the chairman of their major department and upon payment of a nominal fee, take any graduate course offered by the Department of Classics of the University of North Carolina. A list of these courses will be sent upon request.

*Not offered in 1974-75.

Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve, however, in the minor programs of students in other departments. Consult Professor Salinger in the Department of Germanic Languages and Literature.

201, 202. Romanticism. Studies in the origin, rise, and development of the Romantic Movement in the chief literatures of the Western world. The approach is comparative; the principal emphasis will be on England, France, and Germany with some reference to other countries. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. 3 units per semester. Salinger

203, 204. Realism and Symbolism. Comparative studies in the literatures of England, France, Germany, Russia, the Scandinavian countries, Spain, and Italy, tracing the decline of romantic individualism and the reappraisal of man's significance against the social background. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. 3 units per semester. Salinger

205. Foundations of Twentieth Century European Literature. The roots of the contemporary scene (Proust, Mann, Rilke, Kafka, Lagerkvist, Camus, Gide, and Hesse) evolving toward a mythology of man. 3 units. Salinger

206. Autobiography. Origins and developments in the chief European literatures, including autobiographies of St. Augustine, Montaigne, Bunyan, Rousseau, Goethe, Carlyle, Mill, Nietzsche, Yeats, and Jung. 3 units. Clubbe

213. The Slavs: Literature and Culture, 1918-1939. (See course description under Slavic Languages and Literatures 213.) 3 units. Krynski

214. The Slavs: Literature and Culture, 1940-1970. (See course description under Slavic Languages and Literatures 214.) 3 units. Krynski

301. The Hero in European Fiction, 1830-1940. Studies in the "loss of self" from Balzac to Robert Musil. Intended primarily for minors in comparative literature. Prerequisite: permission of instructor. 3 units. Salinger

Computer Science

Professor Loveland, Chairman (407 Computation Center); Associate Professor Patrick, Director of Graduate Studies (408 Computation Center); Professors Gallie, Marinos, Naylor, Nolte, and Woodbury; Associate Professors Hammond and Starmer; Assistant Professors Biermann, Gerhart, and Ramm; Adjunct Associate Professor Williams

The Department of Computer Science offers programs leading to the A.M. and Ph.D. degrees.

A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus and of at least two computer programming languages. Research interests of present faculty include mathematical foundations of computer science, artificial intelligence, program verification, compiler design, real-time computing, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

For Seniors and Graduates

201. Programming Languages. Information binding, data structures and storage, control structures, recursion, execution environments, and input/output. Syntax and semantics of languages. Study of: PL/I, Fortran, Algol,

APL, LISP, SNOBOL, and SIMULA. Exercises in programming. Prerequisite: Computer Science 152. 3 units. Gerhart

203. Random Signals and Noise. (See course description for Electrical Engineering 203. Also listed as Electrical Engineering 203.) 3 units. Kerr and Nolte

205. Signal Detection and Extraction Theory. (See course description for Electrical Engineering 205. Also listed as Electrical Engineering 205.) 3 units. Nolte

208. Digital Computer Design. (See course description for Electrical Engineering 208. Also listed as Electrical Engineering 208.) 3 units. Marinos and Owen

210. Image Processing. Digital image transducers and processing algorithms, special purpose filters and tracking algorithm as applied to both binary and multi-gray level images; transducer hardware such as flying spot scanners and image dissectors. 3 units. Starmer

211. Control Programs in Operating Systems. Review of control programs such as task scheduling, memory allocation and I/O control. Identification of the common features of control programs and the hardware-software tradeoffs required for implementation. Prerequisite: Computer Science 231. 3 units. Starmer

212. Advanced Topics in Control Programs. Resource allocation; simulation of various algorithms to identify constraints in a hypothetical system. Prerequisites: Computer Science 231 and 211. 3 units. Starmer

215. Artificial Intelligence. Heuristic versus algorithmic methods; programming of games such as chess; theorem proving and its relation to correctness of programs; readings in simulation of cognitive processes, problem solving, semantic memory, analogy, adaptive learning. Prerequisite: Computer Science 152 or permission of instructor. 3 units. Biermann

221. Numerical Analysis I. Error analysis and interval arithmetic, interpolation and polynomial approximation methods, numerical differentiation and integration, solution of simultaneous linear equations and matrix inversion, real and complex roots of non-linear equations. Prerequisite: knowledge of an algorithmic programming language and intermediate calculus. (Also listed as Mathematics 221.) 3 units. Patrick

222. Numerical Analysis II. Calculation of eigenvalues and eigenvectors, numerical methods for solving ordinary differential equations, partial differential equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) 3 units. Patrick and Utku

223. Numerical Analysis III. Rational approximation methods, spline approximations, optimization techniques, global methods for solving non-linear algebraic equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 223.) 3 units. Patrick

225. Mathematical Foundations of Computer Science. Introduction to basic concepts and techniques used in mathematical models of computation. Elements of the predicate calculus; applications to automatic theorem proving and verification of programs. Computable sets, functions, algorithmically unsolvable problem. Regular and context-free formal languages and the machines that define them. Prerequisite: four semesters college mathematics. 3 units. Loveland

231. Introduction to Operating Systems. Characteristics and components

of operating systems and methods for their implementation. Program linkage and relocation, job scheduling, resource allocation and interrupt handling, input/output control systems, on-line file structures, communications, time sharing and real-time systems. Case studies of existing systems. Prerequisite: Computer Science 150 or 152. 3 units. Ramm

232. Metaprograms. Programs which process programs: compilers, interpreters, assemblers. Syntax and semantics of programming languages. 3 units. Gallie

241, 242. Information Organization and Retrieval. Structure, analysis, organization, storage, searching, and retrieval of information. Emphasis on structure of files, dictionary construction and look-up, search and matching procedures, indexing, file maintenance, and methods for user interaction with the automated system. Programming experience included. Prerequisites: Computer Science 152. 3 units per semester. Hammond

244. Computer Simulation Models of Economic Systems. (Also listed as Economics 244.) 3 units. Naylor

250. Clustering and Classification. Algorithms and operating characteristics of clustering and classification methods. Data models for sequential data acquisition, clustering in terms of nearest neighbor, and/or mixtures of distributions (missing information principle). Characterization of patient groups versus normal groups and selection of measures to characterize diseases as super-clusters. Application of Bayes' procedures to classification into clusters and super-clusters. Prerequisite: permission of instructor. 3 units. Woodbury

251. Computer Science for Teachers. An introduction to digital computation which concentrates on computer instruction in the high school and on the employment of computer processes in instruction and school administration. Prerequisite: a year of basic mathematical analysis at college level. Summer session. 3 units. Staff

265. Advanced Topics in Computer Science. 3 units. Staff

306. Adaptive Detection and Communication Systems. (See course description for Electrical Engineering 306. Also listed as Electrical Engineering 306.) 3 units. Nolte

307. Advanced Digital Systems I. (See course description for Electrical Engineering 307. Also listed as Electrical Engineering 307.) 3 units. Marinos

308. Advanced Digital Systems II. (See course description for Electrical Engineering 308. Also listed as Electrical Engineering 308.) 3 units. Marinos

311. Inverse Models. (See course description for Biomedical Engineering 311. Also listed as Biomedical Engineering 311.) 3 units. Pilkington

321. Topics in Numerical Mathematics. Advanced topics in numerical mathematics to be selected from areas of current research. Prerequisites: Computer Science 221 and 222 or 223. 3 units. Patrick

344. Workshop on Computer Models of Social Systems. (See course description for Economics 344. Also listed as Economics 344 and Political Science 344.) 3 units. Naylor

350. Advanced Engineering Analysis. (See course description for Civil Engineering 350. Also listed as Civil Engineering 350.) 3 units. Utku

Economics

Professor Kelley, Chairman (215-A Social Science); Associate Professor

Weintraub, Director of Graduate Studies (315 Social Science); Professors Blackburn, Bronfenbrenner, Davies, de Vyver, Goodwin, Kreps, Naylor, Saville, Treml, Vernon, and Yohe; Associate Professors Grabowski and Havrilesky; Assistant Professors Black, de Marchi, Graham, McElroy, and Salkin

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. Among the undergraduate courses of distinct advantage to the graduate student in economics are general accounting, elementary statistics, intermediate economic theory, money and banking, international trade, and basic courses in philosophy, mathematics, and social sciences other than economics. Advanced work in mathematics or statistics is also useful.

Requirements for the Ph.D. degree in economics include examination in economic theory at the end of the first year, and, at the end of the second year, examinations in three additional fields. The student may select from advanced economic theory, history of political economy, economic development, economic history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, statistics, Soviet economics, and certain fields outside the economics department (e.g.; demography). Course work for the Ph.D. degree should be completed in four semesters of residence.

For Seniors and Graduates

200. Capitalism and Socialism. Selected ideological classics of new and old right and left economics including both "counsels for perfection" (Utopias) and "precepts for action" in political economy. 3 units. Bronfenbrenner

204. Advanced Money and Banking. Monetary theory and its statistical and institutional implementation. Particular attention is given to the development of aggregative theories of prices, interest rates, and production; the functioning of monetary policy within various theoretical frameworks; and appraisal of the recent use and the limitations of Federal Reserve policy. 3 units. Havrilesky and Yohe

231. Economic Development of Europe. Sequence of local, national, and international economic structures under situations of changing trade, industry, agriculture, population, investment, war conditions, public ownership, cartels, colonialism, and prices. 3 units. Saville.

***233. State and Urban Finance.** Expenditures, taxation, and financial administration in state and local governments, with emphasis on current problems. Special attention will be given to research methods and materials, and to the financial relations between state and local government. 3 units. Black and Davies

237, 238. Statistical Methods. A study of statistical methods appropriate for dealing with problems in business and the social sciences. In addition to developing more thoroughly the subject considered in Business Statistics, the following methods will be considered: multiple, partial, and curvilinear correlation; curve fitting; probability; sampling distributions; and statistical inference. Prerequisite: Economics 138 or consent of the instructor. 3 units per semester. Staff

243. Econometrics I. Economic theory, mathematics, statistical inference, and electronic computers applied to analysis of economic phenomena. Objective is to give empirical content to economic theory. Matrix algebra used to develop topics in inference, linear regression, and systems of

*Offered on demand.

simultaneous equations. Use is made of the electronic computer. 3 units. Naylor

244. Computer Simulation Models of Economic Systems. A course on the design of computer simulation experiments for economic systems. Topics include generation of stochastic variates, computer models of queuing and inventory systems, models of the firm and industry, models of the economy, simulation languages, and experimental design. (Also listed as Computer Science 244.) 3 units. Naylor

245. Econometrics II. Advanced theory and applications: includes specification error, generalized least squares, lag structures, Bayesian decision-making simultaneous equation methods, and forecasting. Emphasis on current applied literature. A Track 1, third-level course. Prerequisite: Economics 243. 3 units. McElroy

262. Trade Unionism and Collective Bargaining. An intensive survey of the trade union as an economic institution is followed by a study of the principles and problems of union-management relationship as found in collective bargaining. 3 units. de Vyver

265. International Trade and Finance. A study of the fundamental principles of international trade and foreign exchange. Subjects covered will include international specialization, balance of payments, foreign investments, tariffs, and commercial policies, exchange control, exchange rates, and international monetary problems. 3 units. de Marchi

287. Public Finance. Examines the economic aspects of such problems as the growth of government, the proper role of the state, the centralization and decentralization of government, government bureaucracy, the impact of taxes and spending on the wealthy and the poor, as well as other public policies and questions. 3 units. Davies

293. Soviet Economic History. Establishment of foundations of a socialist economy: collectivization, industrialization, and search for economic efficiency. 3 units. Treml

294. Soviet Economic System. Economic planning and administration in the Soviet Union and other socialist countries. International comparisons. Theoretical and applied problems of resource allocation, economic development, and optimal microdecision-making in a nonmarket economy. 3 units. Treml

301. Microeconomic Analysis I. Review of contemporary theory relating to production, the firm, and income distribution in competitive and imperfectly competitive markets. 3 units. Graham

302. Microeconomic Analysis II. A continuation of Economics 301 with emphasis on analyses of consumer behavior, general equilibrium, welfare economics, and capital theory. Prerequisite: Economic 301. 3 units. McElroy, Salkin, and Weintraub

303. Theory of Economic Decision-Making. The extension of economic theory to the allocation of resources within firms and governmental units. Prerequisite: Economic 301 or its equivalent. 3 units. Staff

304, 305. Monetary Theory and Policy. In the first semester: theories of the supply of and demand for money (neoclassical and Keynesian macroeconomic), general equilibrium theories, and theories of the term structure of interest rates. In the second semester: the theory and practice of the monetary policy with emphasis on recent issues, the monetarist-fiscalist controversy, the monetary policy transmission mechanism, and policy simulations with econometric models. 3 units per semester. Havrilesky and Yohe

307. Quantitative Analysis I. A systematic analysis of the principal quantitative methods used in microeconomic theory. Neo-classical theories of production and distribution are used as vehicles for presenting the material. Considerable emphasis is placed on the application of mathematical analysis to economic models. 3 units. McElroy

308. Quantitative Analysis II. Linear economic models, particularly Leontief models, are used in the exposition. Primary emphasis is placed on the application of mathematics to economic theory. Prerequisite: Economics 307 or consent of instructor. 3 units. Graham

311, 312. History of Political Economy. A detailed review of the development of economic theory, the tools of economic analysis, and economics as a science, together with an analysis of the circumstances affecting this development. Period covered: pre-Christian times through 1936. 3 units per semester. Goodwin

313, 314. Seminar in Economic Theory. Prerequisite: Economics 301 or its equivalent. 3 units per semester. Weintraub

316. Seminar in Economics of Soviet-Type Socialism. Selected topics in analysis of theoretical and institutional framework of Soviet economic system, such as markets versus plan, optimizing techniques in planning, price determination, balanced economic development, and ideology and economic policy. 3 units. Treml

317. Seminar in Demographic, Population, and Resource Problems. 3 units. Staff

318. Dissertation Seminar. 3 units. Staff

319. Seminar in the Theory and the Problems of Economic Growth and Change. 3 units. Staff

320. Macroeconomic Analysis I. Measurement of national income and other important aggregates; classical macroeconomics; Keynesian and more recent views of the determinants of income, employment, and price levels; empirical studies of consumption, investment, and monetary variables. 3 units. Blackburn, Bronfenbrenner, and Weintraub

321. Theory of Quantitative Economic Policy. The use of mathematical models in analyzing the connections between means and ends of economic policy; topics covered include principles and design, centralization and decentralization, stabilization and growth policies, welfare optimization, imperfect models, and the use of control system analysis. Prerequisite: Economics 320. 3 units. Staff

322. Macroeconomic Analysis II. Further analysis of topics treated in Economics 320. Optimal economic growth; business cycles. Issues in economic policy. Prerequisite: Economics 320. 3 units. Graham and Weintraub

323. Income Distribution Theory. Income distributions—functional and personal. Concepts and measures of poverty and inequality. Maldistribution issues—ethical and economic. Pricing of productive services, primary attention on wages and employment. Rival aggregative (macro distribution) theories. Prerequisites: intermediate micro- and macro-economics and some knowledge of calculus and statistics. Bronfenbrenner

329. Federal Finance. An analysis of the trends and hypotheses concerning the growth in governmental activity, the optimum level and composition of governmental spending, and the microeconomic and macroeconomic effects of governmental spending and tax policies. 3 units. Davies

330. Seminar in Public Finance. 3 units. Davies

331. Seminar in Economic History. 3 units. Staff

344. Workshop on Computer Models of Social Systems. A course on the methodology of constructing computer simulation models of social systems including political, economic, social, administrative, and educational. Although the emphasis of the course is on a variety of different types of models of social systems, special consideration is given to the methodology of designing simulation experiments. (Also listed as Computer Science 344 and Political Science 344.) 3 units. Naylor

345, 346. Demographic Techniques I and II. (Also listed as Sociology 345, 346.) 3 units each semester. Myers and Hartford

350. Seminar in Applied Economics. A course that will use the principles of micro-economics in the analysis of problems and policies. The particular contextual materials that will be subjected to analysis will vary from time to time. Materials will be treated in the tradition of positive economics.

355. Seminar in Labor Economics. 3 units. de Vyver

358. Seminar in Labor Market and Related Analysis. 3 units. Staff

365. Seminar in International Economics. 3 units. de Marchi

366. Monetary Aspects of International Trade and Finance. The monetary, as opposed to the pure, side of international economics. Among the topics considered are the balance of payments, the foreign-exchange market capital movements, payments equilibrium, the demand for reserves, and international monetary reform. 3 units. Staff

***388. Industrial Organization.** The theory, measurement, and history of the firm-structure of industry. Emphasis upon the structure of American industry and upon actual production and pricing practices. Criteria for evaluating industrial performance. 3 units. Vernon and Grabowski

***389. Seminar in Industrial and Governmental Problems.** 3 units. Vernon

397, 398. Directed Research.

401. Seminar on the British Commonwealth. 3 units. Ball, Preston, and Others of the Committee on Commonwealth Studies

402. Interdisciplinary Seminar in the History of the Social Sciences. 3 units. Goodwin, Holley, and Spragens

Related Courses in Other Departments

Courses in related fields may be selected from anthropology, computer science, forestry, history, mathematics, philosophy, political science, and sociology, or from an area that complements the candidate's area of research interests in economics.

See Program in Comparative Studies on Southern Asia and the Center for Demographic Studies in the chapter on Special and Cooperative Programs for further information.

Education

Professor Hurlburt, Chairman (213I West Duke Building); Professor Cartwright, Director of Graduate Studies (213A West Duke Building); Professors Adams, Gehman, Githens, Hopkins, Petty, Shuman, Tuthill, and Weitz; Associate Professors Ballantyne, Carbone, Colver, L. Davis, Di Bona, Flowers, Johnson, Katzenmeyer, Martin, Pittillo, and Sublett; Adjunct Professor J. Davis; Part-time Instructor Swain

Graduate work in education is offered leading to the A.M., the M.Ed.,

*Offered on demand.

the M.A.T., the Ed.D., and the Ph.D. degrees. For each of these degrees there are specific requirements and prerequisites, all of which may be found stated in detail in this Bulletin. Departmental requirements and prerequisites for all of these degrees may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selection may be made which will meet North Carolina requirements for the Advanced Principal's Certificate, the Superintendent's Certificate, and the Supervisor's Certificate.

(Some courses below are offered only in the summer session; see the Bulletin of the Summer Session.)

These programs are accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel with the doctor's degree as the highest degree approved.

For Seniors and Graduates

201. Teaching and Supervision of Arithmetic. Special attention is given to the number system, the fundamental operations (with whole numbers, fractions, and decimals), percentage, and measurements. Considered also are the meaning theory, methods of teaching, problem-solving, evaluation, practice and drill, and selection and gradation of arithmetical contents. Designed for teachers and supervisors in elementary schools. 3 units. Petty

202. Comparative and International Education: Industrialized Nations. Structure and functioning of educational institutions in selected developed societies. Emphasis on relevant social science theory and methods. 3 units. Di Bona

204. Educational Organization. Explores theory and research on the processes of exchange between educational organizations and their external environments, and the influence of these processes on organizational structure, goals, and practices. Schools, colleges, and universities are considered as separate types of educational organizations, and a comparative approach is emphasized in examining these as well as other forms of social organizations, e.g., hospitals, businesses, and prisons. 3 units. Martin

206. Studies in the History of Educational Philosophy. The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. 3 units. Carbone

207. Social History of Twentieth Century American Education. Twentieth century American education in the context of social and intellectual history. 3 units. Johnson

209. John Dewey. Dewey's major writings with emphasis on his philosophy of education. 3 units. Carbone

210. The Politics of Education. (See course description for Political Science 210. Also listed as Political Science 210.) 3 units. Leach

***213. Elementary School Organization and Administration.** This course is designed especially for principals, teachers, and other prospective members of the elementary school staff. The scope of elementary education is considered to encompass nursery school, kindergarten, and the elementary school. Special treatment is given to the problems of internal organization and management of the elementary school, and its integration with the secondary-school level. 3 units. Sublett

*Offered on demand.

215. Secondary Education: Principles. Principles, curriculum, and methods in secondary education. Prerequisite: C average overall and in teaching field or fields. Must be accompanied by Education 216. 3 units. Cartwright, Githens, Johnson, and Shuman

216. Secondary Education: Internship. Supervised internship in junior or senior high schools. Full-time observation and teaching for half a semester, accompanied by Education 215; or, with permission of the department, full-time teaching for a semester, accompanied by Education 315. Students carrying Education 216 for credit toward a master's degree will be required to take six hours of senior or graduate work in addition to the normal degree requirements. 6 units. Cartwright, Githens, Hurlburt, Johnson, and Shuman

217. The Psychological Principles of Education. An advanced study of teaching, learning, and the learner. Selected problems guiding the reading of students will be discussed in class. 3 units. Davis, Gehman, and Weitz

218. Comparative and International Education: Developing Societies. Structures and functioning of educational institutions and processes in developing nations. 3 units. Di Bona

219. Comparative and International Education: South Asia. Traditional and modern educational developments in India and Pakistan. 3 units. Di Bona

221. Programs in Early Childhood Education. Examination of the objectives and philosophy underlying programs in early childhood education, including an overview of existing practices, research findings, and experimental projects dealing with social, emotional, physical, and cognitive development. 3 units. Flowers

222. New Developments in Elementary School Curriculum. The open classroom, team teaching, non-graded programs, and individualized instruction. Assessment of recent emphasis on early childhood education and the middle school. 3 units. Sublett

***223. Teaching the Language Arts.** Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. Increasing opportunities for creative expression. Correlation of language arts with other activities and school subjects. 3 units. Adams

224. Teaching the Social Studies in Elementary Schools. 3 units.

225. The Teaching of History and the Social Studies. Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. 3 units. Cartwright

226. Teaching Developmental and Remedial Reading in the Elementary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. Practice is provided with elementary school children suffering reading retardation, in testing, diagnosis, and daily remedial teaching. 3 units. Adams

227. The Teaching of Geography. 3 units.

229. Formal and Informal Classroom Diagnosis of Reading Disability Cases. Designed to acquaint teachers, supervisors, and administrators with various standardized tests, other instruments, and informal procedures utilized in diagnosing reading problems of elementary and secondary pupils. 3 units. Adams

*Offered on demand.

233. Improvement of Instruction in English. This course will acquaint the student with recent developments in the teaching of English and will introduce him to research techniques in the field. Each student will pursue an extensive independent study based on his particular interests. 3 units. Shuman

234. Secondary School Organization and Administration. This course is designed especially for principals, teachers, and other prospective members of the secondary school staff. The scope of secondary education is considered to encompass junior high school, regular high school, senior high, and junior college. Special treatment is given to the problems of internal organization and management. 3 units. Pittillo

236. Teaching Developmental and Remedial Reading in the Secondary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. For secondary school teachers of all subjects who wish to improve the reading and study habits of their students. 3 units. Adams

237. The Teaching of Literature in Secondary Schools. Literature generally taught in secondary schools. Adult and transitional literature are considered. Methods of organizing the program and of teaching literature. 3 units. Shuman

238. Content, Supervision, and Administration of Reading Programs. The nature and functions of the objectives of various reading programs, organization of such programs, their major attributes, and their evaluation. For supervisors, teachers, and administrators. 3 units. Adams

239. The Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School. Recent development in the teaching of grammar, composition, mechanics, and usage. Students will write and grade compositions. Term project. 3 units. Shuman

240. Career Development. An analysis of the world of work; socio-personal factors affecting occupational choice; theories of career development; and use of occupational and educational resources. 3 units. Ballantyne and Colver

241. Foundations of Counseling and Personnel Services. Scope, principles, historical background, services, trends, and issues of counseling and pupil personnel services. 3 units. Ballantyne and Colver

243. Personality Dynamics. A study of personality structure and dynamics with emphasis upon the implications for counseling and instruction. Prerequisite: six hours of psychology or educational psychology. 3 units. S. Gehman

244. Counseling Techniques. A study of individual counseling techniques including diagnosis, interviewing, program planning, and counseling evaluation. Prerequisites: Education 243 and 258 or equivalent, which may be taken concurrently. 3 units. S. Gehman

245. Theories of Counseling. A study of the major theories of counseling. 3 units. Weitz

246. The Teaching of Mathematics. This course deals with such topics as aims, curriculum, course and lesson planning, and classroom procedure for teaching secondary school mathematics. 3 units.

247. Practicum in Guidance and Counseling. Intensive field experience in local settings, designed to provide the student with opportunities to partici-

pate in on-going counseling and guidance programs. A minimum of 150 hours of case work and supervision required. Prerequisites: Education 244 and permission of instructor. 3 units per semester. May be repeated. Ballantyne, Colver, Gehman, and Weitz

248. Practicum in Counseling. Practice in individual counseling, including test administration, intake interviewing, diagnosis, program planning, report preparation and evaluation. The student will be expected to devote approximately 150 hours to case work and conferences with his supervisor. Prerequisite: permission of instructor. 3 units per semester. May be repeated. Ballantyne, Gehman, and Weitz

249. Exceptional Children. A survey of the major categories of exceptional children, mental retardation, emotional disturbance, brain injured, learning disabilities, physically handicapped, visual and auditory deficits, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment will be discussed. 3 units. Davis

250, 251. Teaching Emotionally Disturbed Children: Internship. Basic principles and practices in teaching and the organization of instructional materials. Work with children under the supervision of a certified teacher of emotionally disturbed children. Experience in general classroom teaching and small group and individualized instruction. Participation in staff conferences involving psychiatrists, psychologists, social case workers, and professional educators. 3 units per semester. S. Gehman

***252. The School in the Legal Structure.** Designed to show the legal relationships of the school to federal, state, and local governments. Considerable attention to legal rights, responsibilities, and liabilities of the teacher. 3 units. Martin

253. Law and Education. The elements and problems of educational organization which have come within the purview of constitutional and legislative provisions and appellate court decisions. 3 units. Martin

255. Assessment of Abilities. The selection, use, and interpretation of various instruments for predicting and evaluating the outcome of educational experiences, including surveys of standardized tests of aptitude and achievement. 3 units. Colver

256. Classroom Assessment of Student Achievement. The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. 3 units. Colver

258. Assessment of Personality, Interests, and Attitudes. The rationale, construction, use, and interpretation of standardized instruments designed for the assessment of student's interests, attitudes, and personality. Emphasis on counseling applications. Prerequisites: Education 243 and 255 or approval of instructor. 3 units. Weitz and Colver

260. Introduction to Educational Research. Research methodologies: experimental, historical, survey, philosophic, and case study. Fundamentals of statistical inference, research design, and computer applications to research problems. 3 units. Katzenmeyer

261. Intermediate Educational Research. Intermediate topics in statistical inference. Analysis of covariance and multiple regression. Computer applications in research. Research design. Prerequisite: Education 260 or its equivalent. 3 units. Katzenmeyer

*Offered on demand.

266. Basic Science for Teachers. Presentation of basic concepts in natural and physical science through selected readings, the use of simple experiments and demonstrations, construction and use of equipment, and field studies. 3 units. Githens

268. Seminar in Contemporary Educational Criticism. Critical analysis and discussion of the writings of contemporary critics of education. 3 units. Carbone, Di Bona, Johnson, and Martin

270. The Junior College. A study of the history and role of the junior college, and of problems and issues confronting the two-year college. Designed as an introduction to the junior college for students preparing to be teachers or administrators. 3 units. Hopkins and Hurlburt

271. Instructional Systems for Junior/Community Colleges. Study of alternative instructional approaches and systems for junior/community colleges with special attention to the systems approach and the individualization of instruction for a heterogeneous student population. 3 units. Hopkins

272. Teaching Communication Skills in Early Childhood Education. An examination of the development of communication skills from birth to age eight with emphasis on reading readiness and language growth. 3 units. Adams

273, 274. Clinical Reading Practicum. Clinical experiences in the diagnosis and correction of reading disabilities in elementary and secondary students. Prerequisite: permission of instructor. 3 units per semester. Adams

276. The Teaching of High School Science. Discussion, lectures, and collateral reading, related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary-school science. 3 units. Githens

285. Audiovisual Aids in Education. The aims and psychological bases of audiovisual materials in the classroom. Attention to such materials as charts, filmstrips, flat pictures, maps, models, motion pictures, radio, records, slides, and television. Offered in summer only. 3 units.

291. Public and Community Relations of School. 3 units.

For Graduates

300. Individual Assessment of Intelligence. Individual intelligence as measured by standardized individual instruments, chiefly the Wechsler Intelligence Test for Children and the Stanford-Binet L-M. Theory, administration, scoring, analysis, interpretation, and reporting. Work with children in supervised school settings. Prerequisite: permission of instructor. 3 units. Davis

301. Advanced Individual Assessment of Cognitive Abilities. Development of advanced understanding and skills in the use of clinical instruments for assessment of cognitive abilities. Analysis, interpretation, and consultation about individual assessment. Supervised experience involving collaboration with children, school personnel, parents, and clinic and community representatives. Prerequisites: Education 300, or equivalent, and permission of instructor. 3 units. Davis and Gehman

302. Seminar in Educational Research. The seminar is primarily for students working on dissertations and theses. Students submit research proposals, plan a research project, and make periodic progress reports. Special topics are considered as appropriate to the research designs developed. Prerequisite: Education 260 or 261. 3 units. Katzenmeyer

306. Seminar in Philosophical Analysis of Educational Concepts. Selected writings of contemporary philosophers, with special emphasis on such educational concepts as teaching, learning, knowing, understanding, indoctrination, explanation, and education. 3 units. Carbone

309. Higher Education in the United States. Study of the major issues, problems, new developments, and prospects for higher educational institutions. 3 units. Hopkins

310. Seminar in Higher Educational Administration. New developments in the organization and administration of higher educational institutions. Special attention to administrative and organizational systems, management information systems, and managerial accountability. 3 units. Hopkins

311. Group Counseling. A study of theories and techniques of counseling for small groups of children, adolescents, teachers, parents, and other adults. Simulated practice through recorded interviews and transcribed counseling sessions. Prerequisites: Education 244 and Education 245. 3 units. Gehman

313. Seminar in Education and Public Policy. The relationship of educational administration to the public policy process. (Also listed as Political Science 313.) 3 units. Leach and Pittillo

314. Seminar in Guidance and Counseling. Research, writing, and reporting on selected problems in the field of guidance and counseling. 3 units. Weitz

315. Seminar in Secondary School Teaching. Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit, this course must be accompanied by Education 216. 3 units. Carbone, Hurlburt, and Johnson

316, 317. Practicum in Higher Educational Research and Development. Review of the purposes and essential stages of research and development in higher education, followed by individual projects covering problem identification, literature searches, new product specifications and design, and development and pilot testing of prototype product. Enrollment limited to five students. 3 units. Hopkins

321. Educational Management. A study of theory and practice of management as applied to education. This course is intended for anyone who has or is preparing to have major management responsibilities in the field of education. 3 units. Pittillo

322. Planning and Management of Educational Facilities. A study of planning and management of educational facilities and equipment. This course is intended for teachers, administrators, and supervisors. 3 units. Pittillo

***323. Public School Finance.** A study of educational costs, sources of revenue for the support of public education, collection of revenue, basis of distribution, and accounting for funds spent. 3 units. Pittillo

326. Educational Psychology: The Problem Child. Study of problem behavior and adjustment in children with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid to mental hygiene principles in the handling of problem children in school and home. 3 units. I. Gehman

*Offered on demand.

332. Supervision of Instruction. A study of the nature of supervision, underlying principles, and techniques of working with individual teachers and with groups. 3 units. Hurlburt

335, 336. Seminar in School Administration. Organization and control over public education. First semester: attention to governance of education as exercised by the different branches and levels of government. Second semester: administrative organization. 3 units per semester. Hurlburt, Petty, Pittillo, and Sublett

337. Seminar in Community College Organization. Discussion of the nature, function, and organization of community colleges. Research, writing, and reporting on selected problems. 3 units. Hurlburt

338. Seminar in Educational Supervision. Open to students who have completed Education 332 or its equivalent. 3 units. Hurlburt

339. Seminar in Curriculum. Research, writing, and reporting on selected problems. 3 units. Cartwright and Sublett

340. Seminar in Social Studies Curriculum. Research, writing, and reporting on selected problems. 3 units. Cartwright

341. Seminar in Elementary School Curriculum. Research, writing, and reporting on selected problems. 3 units. Sublett

342. Seminar in Secondary School Curriculum. Research, writing, and reporting on selected problems. 3 units. Cartwright

343. History of Higher Education in America. A history of the growth and development of higher education in the United States from 1636 to the present. The early role of religious groups in establishing colleges, the continuing role of private higher education, and the evolutionary development of public higher education, including state and land-grant universities, teachers colleges, state colleges, and community colleges, are stressed. 3 units.

344. Research in Higher Education. Review of theory, practice, and contribution of research as an aid in understanding the functioning of institutions of higher education. Emphasis on empirical studies utilizing the approach and methods of social science. Also specific concern with historical, economic, and philosophical approaches. Will consider new or emerging frontiers of study such as channels of access to higher education, assessment of the learning environment, attitudinal changes in college students, and contributions of the college to societal needs. 3 units.

345. Seminar in Reading Instruction and Research. A study of the major problem areas in contemporary reading teaching, with emphasis on theoretical, historical, and philosophical contributions to the formulation of objectives and methodologies in modern reading instruction. 3 units. Adams

346. Seminar in Organization of Pre-Service and In-Service Reading Programs. Student development of various content and instructional strategies for possible implementation in university undergraduate reading and language arts courses and in public school in-service programs. For graduate students interested in teaching reading and language arts courses at the university level or in coordinating and directing in-service education programs in reading. 3 units. Adams

347. Student Personnel Services in Higher Education. A study of the basic objectives of student personnel services in post-secondary education and the administrative procedures developed to achieve these objectives. Attention will be directed to many of the specific personnel services. 3 units. Colver

348, 349. Seminar in Child Psychopathology. Under the direction of a child psychiatrist, the student will select one elementary school age child for a psychoanalytic study of neurotic conflicts, unconscious motivations, dream work, defense mechanisms, and transference phenomena. Prerequisite: permission of instructor. 3 units per semester. Fowler

350, 351. Directed Activities in Education. Selected internship experiences at an advanced level under supervision of appropriate staff. Prerequisite: approval of instructor. 3 units per semester. Staff

354. Seminar in Law and Educational Organization. Research, writing, and reporting on selected problems. Prerequisites: Education 204 and 253, or by consent of instructor. 3 units. Martin

360. Seminar on Instructional Strategies. This seminar provides an opportunity to examine the strategies espoused for effective instruction by a variety of writers, to examine the relationships among broad purposes of education, the process and product objectives, and the strategies employed to achieve those purposes and objectives. A synthesis among the purposes, objectives, and strategies is sought. 3 units. Katzenmeyer

Engineering

George Wilbur Pearsall, Sc.D., Dean (136 Engineering)

The School of Engineering offers programs of study and research leading to the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, electrical, or mechanical engineering. These programs are designed to provide a fundamental understanding of the science of engineering, which is based on mathematics and the physical sciences, and to develop experience in the art of engineering, which depends on human imagination and judgment. Each engineering graduate student may participate in seminars appropriate to his field of study.

A minimum of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (usually mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A non-thesis option requiring 30 units of course credit is available. Each of the departments imposes additional requirements in the exercise of this option. There is no language requirement for this degree.

A minimum of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree in biomedical, civil, and electrical engineering, 24 in the major, 12 in related minor work (often mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department and the Dean of the School of Engineering, and 12 for a research-based dissertation: in mechanical engineering there are no overall course requirements; each program is planned to meet individual needs. The directors of graduate studies will, during the first period of full-time registration of each doctoral aspirant, appoint a program advisory committee consisting of three members of the graduate faculty in areas relevant to the student's intended major. The preliminary examination may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

BIOMEDICAL ENGINEERING

Professor Pilkington, Chairman; Professor Thurstone, Director of Graduate Studies; Professors Bennett, McElhaney, Nolte, and Wolbarsht; Associate

Professors Barr, Clark, Hammond, Hills, and Wachtel; Assistant Professor Evans

Biomedical engineering is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering. The major research areas available include: biomechanics; biomedical materials; biomedical modeling; data acquisition and processing; and electrophysiology.

201. Analysis of Bioelectric Phenomena. Fundamentals of bioelectric modeling with emphasis on neural and cardiovascular systems exhibiting phenomena varying from cellular to the whole organism level. Not open to students who have had B.M.E. 181. 4 units. Wachtel

202. Energy and Rate in Biomedical Processes. An introduction to biomedical thermodynamics and transfer processes with particular emphasis on environmental studies, hyperbaric exposure, and the functions of natural and artificial organs. Not open to students who have had B.M.E. 172. 3 units. Clark and Bennett

223. Biomedical Materials and Artificial Organs. The use of artificial organs to replace or augment natural function in pumping and oxygenation of blood, removal of nitrogenous wastes and other toxins, and prostheses which have mechanical, chemical, or cosmetic function. Emphasis is placed on molecular architecture of materials for use in biological environment and optimization of parameters of materials which determine their utility in varying applications. 3 units. Clark

265. Advanced Topics in Biomedical Engineering. Advanced subjects related to programs within biomedical engineering, tailored to fit the requirements of a small group. Prerequisite: approval of the chairman and the instructor under whom work will be done. 1 to 4 units. Staff

311. Inverse Models. Analytical and computational methods for determining the internal state of a biological system from a set of external measurements and a priori characterization of the system. Particular emphasis is placed on the inherent limitations and difficulties encountered in obtaining numerical solutions from inverse formulations and the value of constraints in reducing these difficulties. (Also listed as Computer Science 311.) 3 units. Pilkington

325. Microcirculation: Rheology and Transport. (Listed also as Physiology and Pharmacology 325.) 2 units. Renkin and Evans

333. Biomedical Imaging. A study of the fundamentals of information detection, processing, and presentation associated with imaging in biology and medicine. Analysis of coherent and incoherent radiation and various image generation techniques. Also covered will be the psychometrics of image evaluation dealing with subjective and objective parameters. Emphasis will be placed upon sonography, thermography, X-ray, various forms of nuclear radiography, microscopy, and holography. 3 units. Thurstone

399. Special Readings in Biomedical Engineering. Individual readings in advanced study and research areas of biomedical engineering. Prereq-

uisite: approval of the Director of Graduate Studies. 1 to 3 units per semester.
Graduate Staff

CIVIL ENGINEERING

Professor Vesić, Chairman (121 Engineering); Associate Professor Dvorak, Director of Graduate Studies (126 Engineering); Professors Brown and Utku; Associate Professors Clough, Muga, Palmer, and J. F. Wilson; Assistant Professors Dajani and Vesilind; Adjunct Assistant Professor Drye

A student may specialize in one of the following fields of study for either the M.S. or the Ph.D. degree: environmental engineering; geotechnical engineering and soil mechanics; mechanics of solids; materials engineering; fluid mechanics, water resources, and ocean engineering; structural engineering; and urban systems and transportation. Interdisciplinary programs combining study in some of the major areas with biological sciences, business administration materials science, social sciences, political science, and other areas of engineering are also available. In addition, there is a special program leading to the M.S. degree in civil engineering and the M.A. degree in public policy sciences.

With the approval of the department, a master's degree candidate in civil engineering may choose, in lieu of submitting a thesis, to complete an additional 6 units of course work plus a special project. If the candidate elects this alternative, he is expected to take a comprehensive examination over his graduate course work, and also to defend orally his special project.

Under the Reciprocal Agreement with Neighboring Universities, a student may include as a portion of the minimum requirements work offered by the Department of Environmental Sciences and Engineering of the University of North Carolina. Although related work normally is taken in the natural sciences or mathematics, a student whose major interest relates to the social or managerial sciences may take relevant work in these areas.

A minimum prerequisite to the graduate program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics.

201. Advanced Mechanics of Solids. Cartesian tensors, dyadics, and matrices. Analysis of states of stress and strain. Conservation laws and field equations. Constitutive equations for elastic, viscoelastic, and elastic-plastic solids. Formulation and solution of simple problems in elasticity, viscoelasticity, and plasticity. Corequisite: Mathematics 285 or equivalent. 3 units. Dvorak

202. Experimental Mechanics. Experimental analysis of stress and strain; correlation of theory with experimental data; errors; photoelasticity; strain gages; brittle lacquers similitude principles and design of models; and dynamic measurements. 3 units. J. F. Wilson

203. Elastic Stability. Linear buckling problems of structures in continuum such as bars, rings, beams, curved beams, thin plates, and thin shells. Linear buckling of structures in discrete space, such as trusses, frames, and discrete representations of plates and shells. Differential equation formulations versus extremum formulations in linear buckling problems. Systematic treatment of buckling problems as linear eigenvalue problems in discrete space and in continuum. Numerical methods for eigenvalue extraction. 3 units. Utku and Wilson

204. Plates and Shells. Formulation of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian thin plates of isotropic and orthotropic material. Solutions in terms of previously tabulated functions. Finite difference

methods. Extremum formulation of the plate problem. Finite difference and finite element methods as applied to the extremum formulation. Folded plates. Numerical solution methods for the folded plates. Membrane theory of thin shells. 3 units. Utku

205. Elasticity. Introduction to linear theory of elasticity. Constitutive equations for anisotropic and isotropic elastic solids. Formulation and solution of torsion, bending and plane problems by semi-inverse, complex potential, and variational methods. Three-dimensional problems. Prerequisite: Civil Engineering 201 or equivalent. 3 units. Dvorak

210. Intermediate Dynamics. (Listed also as Mechanical Engineering 210.) 3 units. J. F. Wilson and Macduff

212. Mechanical Behavior of Materials. Mechanical behavior and its relationship to microstructural deformation and fracture processes in polycrystalline, polymeric, and composite materials. Influence of temperature, strain rate, and environmental conditions on material behavior. Fracture mechanics and its application to brittle and ductile fracture, and fatigue in structural metals, polymers, composites, and concrete. Prerequisite: C.E. 201. 3 units. Dvorak

215. Urban and Regional Geography. Human settlements and locational patterns. Location theory and land-use systems. Normative and descriptive location decisions. Location and impact of constructed facilities. Spatial interaction and network structure. Geography of transportation and environmental quality. 3 units. Dajani

216. Transportation Planning and Policy Analysis. Techniques for the prediction of transportation demand. The transportation planning process: data collection, trip generation, modal choice, trip distribution, and assignment. System evaluation techniques: social, economic, and environmental impacts of transportation. Issues in policy planning and decision-making. Prerequisite or corequisite: C.E. 116 or consent of instructor. 3 units. Dajani

217. Urban and Environmental Systems Analysis. Quantitative approaches to the analysis of public services, activities, and facilities. Mathematical modeling techniques. Optimization of urban and regional systems. Urban growth models. Structuring, solving, and evaluating multi-objective problems in the areas of land use, public services, and environmental quality. Prerequisites: C.E. 117 and Engineering 171 or equivalent. 3 units. Dajani

221. Incompressible Fluid Flow. Steady and unsteady pipe flow, theories of turbulent flow; water hammer theory and control; surge tanks; air chambers; the analysis and control of fluids systems; effect of resistance; tapered conductors. 3 units. Muga

222. Open-Channel Flow. Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, and flow into estuaries and bays. Design of open channel structures, river hydraulics. Design of flood control and navigation structures; culverts, bridge openings, and energy dissipators. 3 units. Muga

223. Flow Through Porous Media. Theory of miscible and immiscible fluid displacement processes. Derivations and solution methods. Selected problems in stability, fingering, and capillarity. Applications; saline water intrusion, secondary recovery processes, seepage through earthen dams, dewatering of construction sites, and well point operation. 3 units. Muga

224. Coastal and Offshore Engineering. Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, wave

spectra. Effects of waves on structures emphasizing design of marine facilities and other selected problems. 3 units. Muga

225. Engineering Hydrology. Study of processes governing the origin, distribution, depletion, and replenishment of water resources and application of this knowledge to the solution of water supply and drainage problems. Topics include the hydrologic cycle, hydrometeorology, precipitation runoff, hydrograph analysis, evapotranspiration, infiltration, groundwater, runoff, stream flow, groundwater recharge, and hydrologic measurements. 3 units. Warner and Vesilind

230. Matrix Methods for Structural Analysis. A study of the displacement method of structural analysis and the use of matrices in the analysis of rigid frames and trusses; applications to multispan and multistory frames and space trusses. Computer solutions are emphasized. Prerequisite: C.E. 140. 3 units. Brown

231. Structural Engineering Analysis. A study in depth of a number of "classical" topics in structural analysis; elastic arch design, plasticity and limit design; numerical and approximate methods; stiffness and flexibility methods are included. Prerequisite: C.E. 140. 3 units. Brown

232. Reinforced Concrete Design. A critical review of research related to the development of existing codes. Special attention is given to the consideration of temperature change effects, shrinkage, plastic flow, bond, shear and diagonal tension. Two-way slabs and flat plates design. Prerequisite: C.E. 133. 3 units. Brown

233. Prestressed Concrete Design. A critical review of research and recent developments in prestressed concrete design. Prestressed tanks, beams and columns, partially prestressing and composite design. Prerequisite: C.E. 133. 3 units. Brown

234. Structural Design in Metals. Design of metal structures using both elastic and plastic theories. Application to plate girders, bridge trusses, and building frames. Interpretation and justification of building codes and specifications. Planning, preliminary design, and organization of design procedures. Prerequisite: C.E. 134. 3 units. Palmer

235. Foundation Engineering. An introduction to methods of analysis, design and construction of foundations. Bearing capacity and settlement of shallow and deep foundations. Soil exploration; excavation and bracing; drainage and stabilization; underpinning. Foundation vibrations. 3 units. Vesić and Clough

236. Earth Structures. An introduction to methods of analysis, design, and construction of earth structures, such as dams, embankments, cuts, canals, and airfield and highway pavements. Selection of materials, soil compaction, and stabilization. Theory of seepage, design of wells, and drainage collectors. Slope stability and related problems. Theory of layered systems and pavement design procedures. 3 units. Clough and Vesić

238. Rock Mechanics. Behavior and properties of rock as an engineering material; failure of rock. Design and construction of underground structures and slopes in rock; design of rock abutments for dams. Laboratory and field rock-testing techniques. Prerequisite: C.E. 139 or consent of instructor. 3 units. Clough

241. Environmental Engineering Chemistry and Biology. Inorganic and organic chemistry as applied to water and waste-water treatment. Chemical equilibria and kinetics. Population dynamics and energy transfer in metabolic systems. Instrumental analysis, including spectrophotometry, chroma-

tography, atomic adsorption. Atmospheric chemistry and analytical methods. Prerequisite: C.E. 124. 3 units. Drye

243, 244. Sanitary Engineering Unit Operations and Process Design. Fundamental bases for design of water and waste treatment systems, including transport, mixing, sedimentation and filtration, gas, transfer, coagulation, and biotreatment processes. 3 units per semester. Vesilind

247. Air Pollution Control. The problem of air pollution with reference to chemical and biological effects. Measurement and meterology of air pollution. Air pollution control methods. Noise pollution, odor, and air pollution law. 3 units. Vesilind

248. Solid Waste Management. Collection, treatment, and disposal of solid wastes from wastewater treatment. Filtration and centrifugation theory and application. Pumping of solid-liquid mixtures. Sludge conditioning by chemicals and heat. Sludge combustion, pyrolysis, and drying. Application of systems analysis to collection of municipal refuse. Sanitary landfills and incineration of solid wastes. Reuse and recycling. Prerequisite: C.E. 124 or consent of instructor. 3 units. Vesilind

250. Engineering Analysis. Formulation of mathematical models selected from a wide variety of engineering disciplines; optimization; use of infinite series, finite difference calculus, energy methods, and digital computers as problem solving techniques. 3 units. J. F. Wilson

304. Advanced Plates and Shells. Differential equation formulation of thin shell problems in general curvilinear coordinates; membrane and bending theories; specialization for shallow shells, shells of revolution and plates. Solution methods in terms of previously tabulated functions; asymptotic integration method; Geckeler's approximation. Finite difference methods as applied to the differential equation formulation. Extremum formulation of the thin shell problems. Numerical solution methods starting from the extremum formulation of the problem. Treatment of nonlinear behavior of shells. Prerequisite: C.E. 204. 3 units. Utku

305. Advanced Elasticity. Complex variable methods in theoretical elasticity; stress, displacement, and mixed boundary value problems in plane strain and longitudinal shear (antiplane strain); axial symmetry. Dynamic boundary value problems; moving loads, punches, and cracks. Prerequisite: C.E. 205 and Mathematics 286. 3 units. Dvorak

306. Plasticity. Mathematical theories of time-independent inelastic material behavior and their experimental foundations. Yield conditions, flow and hardening rules, unloading, shakedown. Theories of limit analysis. Slip-line fields. Numerical methods. Applications to problems in the design of structures, metal forming, stress analysis in metals and composites, and in fracture mechanics. Prerequisite: C.E. 205. 3 units. Dvorak

307. Viscoelasticity. Mathematical theories of time-dependent inelastic behavior of materials and their experimental foundations. Linear and non-linear viscoelasticity; thermoviscoelasticity. Formulation and solution of boundary value problems. Analytical and numerical methods. Applications to problems in stress analysis and design with polymers and composite materials. Experimental methods in viscoelasticity. Prerequisite: C.E. 205 or equivalent. 3 units. Dvorak

309. Advanced Dynamics. Vibration and stability (small and global) of discrete and continuous structural systems; Liapounov's theorems; parametric and random excitation. (Also listed as M.E. 309.) Prerequisite: C.E. or M.E. 210 or permission of instructor. 3 units. J. F. Wilson

331. Advanced Structural Analysis I. Basic theory of elasticity. Energy

theorems. Basic procedures of the displacement method; connectivity matrix, representation of the essential boundary conditions, properties of the elemental matrices, general assembly algorithms. Stiffness matrices and load vectors for line elements, 2- and 3-dimensional elasticity elements, plate and shell elements, solids of revolution elements, and shells of revolution elements. Various specializations of the general upper-lower procedure for symmetric positive definite systems. Computation of stresses in the displacement method. 3 units. Utku

332. Advanced Structural Analysis II. Basic procedures of the force method, equilibrium equations as constraint equations, structure cutter in choosing a basis in the constraint equations, properties of the elemental matrices, and some examples of the element flexibility matrices for various elements. Nonlinear equilibrium problems of structures, incremental load technique. Geometric stiffness matrices for finite elements. Treatment of the general linear buckling problems of the structures. Mass matrices for finite elements. Free vibration problems of initially stressed and unstressed structures. Methods of eigenvalue extraction in positive definite and symmetric systems. Response of structures to deterministic and random dynamic excitations. 3 units. Utku

335. Mechanical Behavior of Soils. Origin of soils, soil minerals, and processes of soil formation; physical chemistry of multiphase systems and soil structure. Permeability and flow of water through soils; capillary and osmotic phenomena; soil compressibility; theory of consolidation; shear strength and failure criteria. Stress-strain relationships, volume changes and pore pressures during shear, strength properties. Advanced laboratory soil testing techniques. 4 units. Vesic

336. Advanced Soil Mechanics. Theories of plastic and elastic equilibrium of soil masses and their application to analysis of problems such as pressure on retaining walls, anchored bulkheads, cofferdams, silos, shafts, and tunnels; stability of slopes; stresses and settlement in soil masses and pavement; piles and pile groups subjected to lateral loads. Prerequisite: C.E. 335. 4 units. Vesic and Clough

337. Elements of Soil Dynamics. Behavior of soils and foundations under transient and impact loads. Mechanics of pile driving. Foundation vibrations. Effects of explosions on soils: wave propagation, cratering. Earthquake effects on foundations, earth dams, and slopes. Compaction of loose soils by explosives or by vibration. Behavior of layered systems under dynamic loads. Prerequisite: C.E. 335 or consent of instructor. 3 units. Clough and Vesic

350. Advanced Engineering Analysis. Review of general mathematical properties of boundary value, eigenvalue and initial value problem in continuum and in discrete space; approximate methods for reducing continuum problems into discrete problems, and comparison of such methods; discussion and comparison of solution algorithms for discrete problems; truncation and round-off errors, and error analysis. Prerequisites: Computer Science 221 and 222 or consent of instructor. (Also listed as Computer Science 350.) 3 units. Utku

365. Advanced Topics in Civil Engineering. Opportunity for study of advanced subjects relating to programs within the Civil Engineering Department tailored to fit the requirements of a small group. 1 to 3 units. Graduate Staff

399. Special Readings in Civil Engineering. Special individual readings in a specific area of study in civil engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. Graduate Staff

ELECTRICAL ENGINEERING

Professor H. Owen, Chairman (130 Engineering); Associate Professor Hacker, Director of Graduate Studies (111 Engineering); Professors Artley, Kerr, Marinos, Nolte, Pilkington, Thurstone, and Wilson; Associate Professors Joines and Wang; Assistant Professor George

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree with a major in electrical engineering: solid state materials and devices; ferromagnetics; super-conducting circuits; instrumentation; electronics; microwaves; automatic control; energy conversion; digital systems; stochastic systems; and information processing.

Recommended prerequisites for the graduate courses in electrical engineering include a knowledge of basic mathematics and physics, electromagnetic theory, and network analysis. Students in doubt about their background for enrollment in specific courses should discuss the matter with the Director of Graduate Studies. The M.S. degree program includes either a thesis or an oral comprehensive examination. A qualifying examination is required for the Ph.D. degree program. These examinations are intended to test both the breadth and depth of the student's understanding of electrical engineering. There is no foreign language requirement.

A program in stochastic system analysis is offered in cooperation with the Department of Mathematics at Duke and the Departments of Statistics and Mathematics at the University of North Carolina at Chapel Hill. For further details concerning this program, refer to the description under Special and Cooperative Programs.

For Seniors and Graduates

203. Random Signals and Noise. Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory: joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. (Also listed as Computer Science 203.) Fall semester. 3 units. Kerr and Nolte

204. Information Theory and Communication Systems. Information and entropy and their application in communication situations. Noise and channel capacity, coding, and the fundamental theorem of information theory. Continuous channels and transmission of band-limited signals. Comparisons of various practical modulation techniques from the standpoint of information rate and error probability. Prerequisite: E.E. 203. Spring semesters 1976, 1978. 3 units. Marinos and Nolte

205. Signal Detection and Extraction Theory. Introduction to signal detection and information-extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Application to problems in communication theory. Prerequisite: E.E. 203 or permission of instructor. (Also listed as Computer Science 205.) Spring semester. 3 units. Nolte

208. Digital Computer Design. Hardware implementation of combinational and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and shift registers. Detail design and simulation of a general-purpose computer system. Computer architectures based on macromodules, hardware compiler implementations, and parallel pro-

cessing concepts are also covered. Selected laboratory work is required. Prerequisite: E.E. 157 or permission of instructor. Spring semester. (Also listed as Computer Science 208.) 3 units. Marinos and Owen

211. Solid State Theory. A treatment of postulatory quantum mechanics and statistical mechanics to serve as a background for the solid state sciences. Topics include both the Schrödinger and matrix formulations, angular momentum, perturbation methods. Maxwell-Boltzmann and Fermi distributions. Prerequisite: permission of instructor. Fall semester. 3 units. George and Hacker

212. Solid State Materials. Concepts of solid state physics as applied to engineering materials; electric, magnetic, thermal, and mechanical properties of solids; dielectrics; semiconductors; magnetic materials; and superconductors. Prerequisite: E.E. 211. Spring semester. 3 units. Artley and Hacker

***213. Principles of Magnetism.** A discussion of the various classes of magnetic materials including diamagnets, paramagnets, ferromagnets, anti-ferromagnets, and ferrimagnets. Typical topics include: crystal field effects, exchange interactions, domain formation, and resonance phenomena. Prerequisite: permission of instructor. 3 units. Artley and Hacker

***215. Semiconductor Physics.** A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include: band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: E.E. 211 or permission of instructor. 3 units. Hacker

217. Masers. Principles of masers, particularly optical masers. Discussion of quantum electronics, optical configuration; solid state, gaseous, and liquid devices; modulation; high power operation. Prerequisite: permission of instructor. Two class sessions and laboratory. Spring 1975, 1977. 3 units. George

221. Nonlinear Networks and Systems. Characterization of nonlinear multi-terminal network elements; formulation of system equations from topological and energy considerations. Basic properties and general methods of solution of resistive nonlinear networks. Time-varying linear systems. Examination of some fundamental properties of nonlinear differential equations. Fall semester. 3 units. Wilson

222. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations—analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance. Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. (Also listed as M.E. 232.) Spring semester. 3 units. Wilson

224. Integrated Electronics: Analog and Digital. Application of integrated circuits for analog and digital systems. Topics include the effect of fabrication techniques on circuitry design, a study of differential and operational amplifiers, and consideration of various logic families such as resistor-transistor logic (RTL), diode-transistor logic (DTL), current-mode or emitter-coupled logic (ECL), and transistor-transistor logic (TTL). Prerequisite: E.E. 161 or equivalent. Fall semester. 3 units. Wilson

*Offered on demand.

225. Semiconductor Electric Circuits. Analysis and design of electronic circuits utilizing a variety of static and dynamic models of semiconductor devices. Transistor and other semiconductor device circuit models; bias stability; high frequency and noise models switching characteristics; illustrative semiconductor circuits. Selected laboratory work. Prerequisite: permission of instructor. Spring semester. 3 units. Joines

227. Network Synthesis. Linear network theory, including a review of time and frequency domain analysis; network graphs; network functions and realizability condition; driving point impedance synthesis of passive networks; driving point and transfer specifications; approximation methods. Prerequisite: permission of instructor. Fall semesters 1975, 1977. 3 units. George

242. Modern Control and Dynamic Systems. See course description for M.E. 230. (Also listed as M.E. 230.) 3 units. Wright

243. Advanced Linear Systems Theory. Linear spaces and linear operators, mathematical description of systems, controllability and observability of Jordan form dynamical equations; multivariable and composite systems; state feedback and state estimators, equivalent systems, and minimal realizations. Observer theory. Design of pole placement compensators. Study of technical papers from various journals. Prerequisite: E.E. 242 or equivalent. Fall semester. 3 units. Wang

***259. Advanced Electric Energy Conversion.** Equations of motion of electromechanical systems; fields and lumped parameters, state function concepts; mathematical techniques for analyzing electromechanical devices and systems; transducers; unified treatment employing matrix, tensor, and block-diagram concepts to obtain response under static and dynamic conditions: the generalized rotating machine. Prerequisite: permission of instructor. 3 units. Trickey

265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and of instructor under whom work will be done. 1 to 3 units. Staff

266. Biofeedback Systems. Instrumentation, on-line computer analysis, and models associated with biofeedback systems. Selected readings considered in conjunction with experience in laboratory biofeedback practices. The physical, physiological, and psychological aspects of biofeedback provide a vehicle for experiential learning which relates individual experience to models used in systems theory, field theory, electronics, and communications. Prerequisite: permission of instructor. Spring semester. 3 units. Artley

271. Electromagnetic Theory. The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, force and energy relations. Prerequisite: permission of instructor. Fall semester. 3 units. Joines

272. Applications of Electromagnetic Theory. Propagation of electromagnetic waves in various structures and media; mathematical description of microwave networks, including equivalent circuits and matrix methods; and microwave circuit theorems and synthesis techniques. Selected laboratory experiments. Prerequisite: E.E. 271. Spring semesters 1976, 1978. 3 units. Joines

*Offered on demand.

297-298. Thesis Research. 6 units.

For Graduates

304. Estimation, Filtering, and Random Systems. Statistical estimation and filtering techniques applied to signal analysis and system identification. Weiner and Kalman filter theory in the estimation of system state variables and system parameters. Statistical treatment of linear random operators and random differential equations. Applications to communications and control with selected computer exercises. Prerequisite: E.E. 203. Fall semester. 3 units. Kerr

305. Advanced Applications of Statistical Decision Theory. Optimum modulators and demodulators, comparison of various systems. Gaussian signals in Gaussian noise; sonar-radar problem, representation of narrow band processes, slowly fluctuating targets, optimum receiver for estimating range and Doppler, properties of autocorrelation functions and ambiguity functions, pseudo-random signals, resolution, frequency spreading, reverberation, active sonar, optimum space-time system, and passive sonar. Prerequisite: E.E. 205. Fall semesters 1974, 1976. 3 units. Nolte

306. Adaptive Detection and Communication Systems. Sequential detection, Wald's sequential probability ratio test, sequential tests of composite hypotheses, deferred decision theory; adaptive systems, nondecision directed and decision-directed measurements, adaptive on-off communications system, transmitted reference systems, detection systems employing the learning feature, learning with and without a teacher, pattern recognition. Applications to communication systems. Prerequisite: E.E. 205. (Also listed as Computer Science 306.) Fall semesters 1975, 1977. 3 units. Nolte

307. Advanced Digital Systems I. A unified treatment of finite-state deterministic systems. Models and elementary properties of sequential machines; sequential machine compatibility; equivalence and state minimization; state assignment for sequential machines; state and machine identification experiments; asynchronous and speed independent switching circuits; theory of regular expressions. Prerequisite: E.E. 157 or permission of instructor. Fall semesters 1975, 1977. (Also listed as Computer Science 307.) 3 units. Marinos

308. Advanced Digital Systems II. A continuation of E.E. 307. Machine decomposition; design of reliable systems from unreliable components; probabilistic and fuzzy automata; recognition devices; automata and their relation to context-free languages. Prerequisite: E.E. 307 or permission of instructor. (Also listed as Computer Science 308.) Spring semesters 1976, 1978. 3 units. Marinos

***313. Magnetic Processes in Materials.** Selected topics in magnetism. Cryomagnetics, spin wave resonance, interaction of superconductor and ferromagnetic materials, nonlinear spin wave theory, effects of finite dimensions and interfaces on basic properties of ferromagnets. Microwave applications. Prerequisite: E.E. 213 or permission of instructor. 3 units. Hacker

321. Nonlinear Magnetic and Semiconductor Circuits. Mathematical description of nonlinear magnetic and semiconductor characteristics; transient and steady-state analysis and synthesis of nonlinear systems with application of such topics as magnetic amplifiers, frequency converters, oscillators, computer logic, switching devices, and inverters. Prerequisite: permission of instructor. Spring semesters 1975, 1977. 3 units. Wilson

*Offered on demand.

324. Nonlinear Oscillations in Physical Systems. Analysis of phenomena encountered in free and forced oscillating systems: stability criteria, topological methods, degenerate systems and discontinuous theories, relaxation oscillations, asymptotic approaches. Emphasis on interdependence of physical and mathematical reasoning in analyzing nonlinear electrical and mechanical systems. Illustrative examples selected to meet interests of class. Prerequisite: E.E. 222. Spring semesters 1976, 1978. 3 units. Wilson

342. Optimal Control Theory. The maximum principle of Pontryagin and the Hamilton-Jacobi equation. Properties and design of optimal systems: minimum-time, -fuel, and -energy problems. Optimal linear systems with quadratic criteria. Classical variational theory: the Euler-Lagrange equation, two-point boundary value problems. The problem of Mayer and Bolza, Riccati matrix differential equation. Dynamic programming of Bellman: multi-stage decision process, principle of optimality and properties of the optimal value function. Selected laboratory work. Prerequisite: E.E. 243. Spring semesters 1975, 1977. 3 units. Wang

345. Stochastic Control Systems. Wiener process, Poisson's processes, Markov chains, stochastic finite-stage machines and semi-Markovian processes. Stochastic control systems, stability of stochastic systems. Mean square error analysis, Wiener filters, statistical equivalent linearization and identification of control systems by statistical techniques. Fixed-memory, expanding-memory, fading-memory filters and Kalman's filters. Stochastic dynamic programming and optimization of stochastic control systems. Prerequisites: E.E. 203 and 243. Spring semesters 1976, 1978. 3 units. Wang

361, 362. Electrical Engineering Seminar-Journal. A weekly seminar in which graduate students and the electrical engineering faculty meet to discuss research and professional activities. Although this carries no graduate credit, it is expected that each graduate student will participate in the seminar for at least two semesters while in residence at Duke University. Artley

***371. Advanced Electromagnetic Theory.** An advanced treatment of topics in electromagnetic theory selected from the interests of the instructor and students. Representative topics are propagation in anisotropic media, plasma waves, antennas, and boundary value problems. Prerequisite: E.E. 272. 3 units. Artley

***373. Selected Topics in Field Theory.** An advanced treatment of topics in generalized field theory selected from the interests of the instructor and the students. Representative topics are generalized fields, electromagnetic interactions, quantum electrodynamics, inhomogenous media, and diffusion phenomena. Prerequisite: E.E. 272. 3 units. Artley

399. Special Readings in Electrical Engineering. Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. Graduate Staff

MECHANICAL ENGINEERING

Professor Chaddock, Chairman (142 Engineering); Assistant Professor Buzard, Director of Graduate Studies (143 Engineering); Professors Garg, Harman, Kenyon, Linderoth, Macduff, and Pearsall; Associate Professors Clark, Cocks, Elsevier, and Shepard; Assistant Professors Munson and Wright; Adjunct Professor Roberts

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in mechanical engineering. Departmental programs of advanced study and research include control systems, dynamics and vibra-

*Offered on demand.

tions, fluid mechanics, heat and mass transport, mechanical design, metallurgy, corrosion, fracture, polymer science, and thermodynamics. The mechanical engineering faculty cooperates with faculty members from a number of other departments and schools to establish interdisciplinary research projects and programs of study in areas which include applied mechanics, biomechanics, biomedical materials, energy conversion, environmental quality and control, interaction of fields and materials, ocean engineering, systems engineering, engineering and public policy, and transportation systems.

The program includes the opportunity for experimental work as well as theoretical study. An increasing emphasis is placed upon developing the research ability of the student and relating the program to the evolving needs of modern engineering practice.

202. Theoretical Thermodynamics. Classical thermodynamics and thermodynamics of continuum properties for real substances, equilibrium, introduction to statistical thermodynamics. 3 units. Harman

210. Intermediate Dynamics. Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies; generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis of flexible continuous systems. (Also listed as C.E. 210.) 3 units. Macduff and J. F. Wilson

211. Theoretical and Applied Polymer Science. An advanced course in materials science and engineering, dealing specifically with the structure and properties of polymers. Particular attention to recent developments in the processing and use of modern plastics and fibers. 3 units. Clark and Pearsall

213. Advanced Materials Science. An in-depth study of current problems in materials applications conducted in a seminar format. Treatment will include thermal, electrical, optical, and magnetic properties of materials in terms of basic physical concepts. Subject intended to provide materials scientists and engineers with a theoretical basis for understanding and manipulating properties. Prerequisites: Engineering 83, and M.E. 111 or 112. 3 units. Cocks, Pearsall, and Shepard

214. Environmental Factors in Materials Science. Effects of environments on the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83. 3 units. Cocks and Shepard

215. Failure Analysis and Prevention. A study and analysis of the causes of failure in engineering materials and the diagnosis of those causes. Elimination of failures through proper material selection, treatment, and use. Case histories. Examination of fracture surfaces. Laboratory investigations of different failure mechanisms. Prerequisite: Engineering 83 or permission of instructor. 3 units. Cocks and Shepard

221. Compressible Fluid Flow. The concepts and analysis for flow of gases in subsonic to hypersonic regime. Two-dimensional flow; oblique shocks; experimental techniques. 3 units. Harman and Munson

222. Heat Transfer. Steady-state and transient solutions of the general heat conduction equation. Development of the equations for transport of energy by fluid motion. Principle of similarity and dimensional analysis in convective energy transport. Solutions of the boundary layer equations. The laws of radiation heat transfer and radiation heat exchange. 3 units. Buzzard and Chaddock

226. Intermediate Fluid Mechanics. A survey of the principal concepts and equations of fluid mechanics. Fluid properties. Statics. Basic equations for the control volume. The differential equations of fluid motion. Stream function. Irrotational flow. Navier-Stokes equations. Kelvin's and Crocco's theorem. Applications to two-dimensional incompressible potential flow and to viscous flow in boundary layers. Prerequisite: M.E. 126. 3 units. Munson

230. Modern Control and Dynamic Systems. The state-space point of view is used as a vehicle to integrate the classic control and modern systems techniques. Topics include vector differential equations, modal matrix transformation, modified canonical forms, and controllability and observability concepts. Also system stability and mathematical modeling methods for lumped- and distributed-parameter systems. Modal control of multivariable control systems. (Listed also as E.E. 242.) 3 units. Wright

231. Systems Response and Control. Methods, applicable to design, of obtaining parameters for strength, response, and stability studies of mechanical systems. Analysis of closed loop control systems with linear transfer functions; electrical and mechanical analogs; introduction to determination of transfer function from input-output characteristics. 3 units. Macduff and Wright

232. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variations of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. (Listed also as E.E. 222.) Fall semester. 3 units. T. Wilson

233. Fluid Control Systems. A design-oriented course concerned with hydraulic and pneumatic feedback control systems. Basic control system characteristics; linearized transfer functions; determination of transfer function from computation and experiment; position, velocity, and acceleration feedback devices; transducers; d.c. and a.c. hydraulic and pneumatic amplifiers. 3 units. Macduff and Munson

235. Advanced Mechanical Vibrations. Analytical and experimental procedures applied to design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques; transfer matrices applied to lumped and distributed systems; analytical and numerical methods of obtaining the pulse response of plane and three dimensional multi-mass systems; convolution and data processing; introduction to random vibration. 3 units. Macduff

236. Engineering Acoustics and Noise Control. Specification of the physical properties of noise, noise measurement, and absorption, transmission and propagation of sound. Effects of noise on man, noise exposure, and damage risk criteria. Legal aspects of noise control, source modification, enclosures, barriers, and personal protectors. Prerequisites: M.E. 123 and Math. 111. 3 units. Macduff

251. Refrigeration and Cryogenics. Theory and experiment in the evaluation of the thermodynamic properties of refrigerants and cryogenic fluids. Simultaneous heat and mass transfer in refrigeration. Production of low and very low temperatures. Two-phase flow processes. Heat exchange for refrigeration and cryogenic transfer. 3 units. Chaddock

255. Energy Conversion. Principles, thermodynamics, and classification of energy conversion devices. Introduction to semi-conductors, thermoelec-

tric generators, photovoltaic generators, thermionic generators, magneto-hydrodynamic generators, fuel cells, and other energy conversion devices. 3 units. Harman

265. Advanced Topics in Mechanical Engineering. Study of advanced subjects in mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and the instructor under whom work will be done. 1 to 3 units. Graduate Staff

270. Theory of Lubrication and Bearing Design. A study and analysis of the theory of hydrodynamic and hydrostatic lubrication. An examination of dynamics of bearing loading, bearing design and materials. Properties of lubricants. Students will work on real bearing problems taken from industry, construction equipment, transportation and wherever relative motion is required between adjacent surfaces. 3 units. Linderoth

280. Nuclear Reactor Power Cycles. Basic reactor principles and types. Examination of most feasible thermodynamic cycles for use with both stationary and mobile power plants. Consideration of safety, shielding, heat transfer, fluid flow, and materials problems unique to reactor design. 3 units. Kenyon

300. Advanced Projects in Mechanical Engineering. This course may be elected by students enrolled in a non-thesis program leading to the Master of Science degree. 3 units. Graduate Staff

302. Advanced Thermodynamics. Classical thermodynamics of inherently irreversible processes. Statistical thermodynamic analysis of properties of real substances and processes. Principles of general thermodynamics. 3 units. Harman

309. Advanced Dynamics. (Also listed as C.E. 309.) 3 units. Wilson

311. Behavior of Crystalline Solids. An advanced treatment of the dependence of structure on atomic bonding, and of properties on structure in crystalline solids. Crystal structures; phase diagrams and solid-state thermodynamics; physical properties; mechanical properties; kinetics of thermal treatments. 3 units. Cocks, Pearsall, and Shepard

322. Mechanics of Viscous Fluids. Equations of motion for a viscous fluid; general properties and selected solutions of the Navier-Stokes equations; laminar boundary layer equations with selected solutions and approximate techniques; origin of turbulence. 3 units. Buzzard

323. Convective Heat Transfer. Models and equations for fluid motion, the general energy equation, and transport properties. Exact, approximate, and boundary layer solutions for laminar flow heat transfer problems. Use of the principle of similarity and analogy in the solution of turbulent flow heat transfer. Two-phase flow, nucleation, boiling, condensation, and simultaneous heat and mass transfer. Prerequisites: Math. 285, M.E. 222 or equivalent. 3 units. Chaddock

324. Conduction and Radiation Heat Transfer. Conduction heat transfer in steady and transient state. Radiation exchange involving absorbing and emitting media including gases and flames, combined conduction and radiation and combined convection and radiation. Exact and approximate methods of solution including separation of variables, transform calculus, numerical procedures, and integral and variational methods. Prerequisites: Math. 285, M.E. 222 or equivalent. 3 units. Buzzard and Chaddock

326. Hydrodynamic Stability. An introduction to the field of the stability of fluid motion. Criteria governing transition from laminar to turbulent or secondary laminar flow. Consideration of small (linear theory) or finite (energy

theory) disturbances; thermal instability of fluid layers; two-dimensional parallel flow; boundary layer and jet instabilities. 3 units. Munson

331. Nonlinear Control Systems. Design of controls for inherently nonlinear systems and the solution of control problems by introduction of nonlinear elements. Stability and optimization. Describing functions and phase-plane techniques for design of nonlinear systems. Parameter analysis. Computer solutions for signal stabilization. Prerequisite: M.E. 232 or permission of instructor. Garg and Wright

333. Seminar in Control Systems. Discussion of modern developments from the areas of system dynamics, linear, nonlinear, and optimal control; development and use of computational techniques for system analysis and synthesis; emphasis on recently published writing in the controls field; topics to be selected to match the interests of the student group; term paper required. Prerequisites: knowledge of basic linear control theory (e.g., M.E. 230, E.E. 243 or equivalent) and computer programming (e.g., M.E. 31, Engineering 31, Computer Science 51 or equivalent) or permission of instructor. 3 units. Garg

335. Analytic Methods in Vibrations. Time and frequency domain analysis, generalized coordinates and Lagrange's equations, natural modes of continuous systems, approximate methods, damped systems, introduction to random vibrations. Prerequisite: M.E. 235 or permission of instructor. 3 units. Wright

372. Finite Element Techniques in Design. Finite element methods applied to design problems in stress analysis; temperature distribution; and flow problems. Derivation of state vectors and transfer matrices for rectangular and triangular elements; accuracy and computation methods; comparison with difference equation methods and available analytical results. 3 units. Macduff

399. Special Readings in Mechanical Engineering. Individual readings in advanced study and research areas of mechanical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. Graduate Faculty

English

Professor Budd, Chairman (323 Allen Building); Professor Nygard, Director of Graduate Studies (315 Allen Building); Professors Anderson, Cady, Duffey, Ferguson, Lievsay, Randall, Reiss, Ryals, Smith, Turner, and Williams; Associate Professors Clubbe, Gerber, Jackson, Jones, Mellown, Monsman, and Strandberg; Assistant Professors Butters and DeNeef

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the A.M. and Ph.D. degrees may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one foreign language for the A.M. degree; for the Ph.D. degree, two languages determined by the student's committee.

For Seniors and Graduates

207, 208. History of the English Language. First semester, Old English grammar and readings; second semester, the development of Middle English and Modern English. 3 units per semester. Nygard and Reiss

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional

and structural grammars; semantic change; the relation of the written to the spoken language; usage. 3 units. Butters, Nygard, and Reiss

210. Old English Literary Tradition. 3 units. Nygard and Reiss

212. Middle English Literary Tradition. 3 units. Nygard and Reiss

215, 216. Chaucer. Reading and interpretation of The Canterbury Tales in the first semester, of Troilus and Criseyde and the minor poems in the second. 3 units per semester. Nygard and Reiss

221. English Prose of the Sixteenth Century. Readings in the major forms and authors. 3 units. Lievsay

222. English Non-Dramatic Poetry of the Sixteenth Century. Extensive select readings from representative types and authors excluding Spenser. 3 units. DeNeef and Lievsay

223. Spenser. A study of his works. 3 units. DeNeef and Lievsay

224. Shakespeare. The plays. 3 units. Williams

225, 226. Tudor and Stuart Drama, 1500-1642. The first semester includes Peele, Lyly, Greene, Kyd, Dekker, Heywood, Chapman, and Marston, with emphasis on Marlowe. The second semester, which emphasizes Jonson, is devoted also to Webster, Beaumont, Fletcher, Massinger, Middleton, Ford, and Shirley. 3 units per semester. Randall

229, 230. English Literature of the Seventeenth Century. Major works in prose and poetry from 1600 to the death of Dryden. 3 units per semester. Jackson (230), Lievsay, Randall, and Williams (229)

232. Milton. Milton's poetry and prose, with emphasis on the major poems. 3 units. Lievsay

234. English Drama, 1642-1800. The heroic play and the comedy of manners of the Restoration; the important plays, serious and comic, of the eighteenth century. 3 units. Jackson

235, 236. The Eighteenth Century. Swift, Pope, Defoe, Addison, Steele, and others are studied in the first semester; in the second, Gray, Johnson, Boswell, Collins, Goldsmith, the novelists, and other writers. 3 units per semester. Ferguson and Jackson

241, 242. English Literature of the Early Nineteenth Century. The Romantic poets and prose writers. First semester, 1790-1810, with emphasis on Blake, Wordsworth, and Coleridge; second semester, 1810-1830, with emphasis on Byron, Shelley, and Keats. 3 units per semester. Clubbe

245, 246. English Literature of the Later Nineteenth Century. The first semester is devoted chiefly to Carlyle, Dickens, Thackeray, Tennyson, and Browning; the second semester to Arnold, Ruskin, Pater, George Eliot, Meredith, the pre-Raphaelites, and Swinburne. 3 units per semester. Clubbe, Monsman, and Ryals

251, 252. English Literature of the Twentieth Century. Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. The first semester will include Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence; the second semester, Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. 3 units per semester. Mellow and Smith

263, 264. American Literature, 1800-1865. The writers emphasized in the first semester are Emerson, Thoreau, and Hawthorne; in the second semester, Poe and Melville. 3 units per semester. Anderson, Budd, Jones, and Turner

267, 268. American Literature, 1865-1910. Selected works of representative authors. The first semester will include Whitman, Lanier, Mark Twain, James, Howells, Emily Dickinson, and the Local Colorists; the second semester, Crane, Norris, Moody, London, Dreiser, Edith Wharton, O'Neill, Robinson, and Frost. 3 units per semester. Budd and Cady

270, 271. Southern Literature. Emphasis in the first semester is on Byrd, Kennedy, Simms, Poe, Timrod, and the humorists; in the second, on Lanier, Harris, Cable, Twain, Glasgow, and Faulkner. 3 units per semester. Turner

275, 276. American Literature Since 1910. First semester, selected fiction from Gertrude Stein to the present. Second semester, poetry from the Imagist movement to the present. 3 units per semester. Duffey and Strandberg

280. Introduction to Folklore. A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. 3 units. Nygard

285. Literary Criticism. A study of the Greek and Roman critics, in chronological order but with emphasis on their permanent value rather than on the history; also of the Continental and English critics to about 1700. 3 units. Lievsay

287. Recent Critical Thought. A survey of ideas relevant to the development of modern literature and its cultural relations. 3 units. Duffey

289. Literary Biography. Reading and discussion of works by Plutarch, Roper, Walton, Aubrey, Mason, Johnson, Boswell, Lockhart, Carlyle, Froude, Gosse, and Strachey: the development of the literary form, its various methods and theories of its nature and purpose. 3 units.

For Graduates

310. Beowulf. Reading and interpretation of the text. 3 units. Nygard

312. Studies in Middle English Literature. The literature of England from 1100 to 1500 (excluding Chaucer); a study of medieval genres with a close reading of selected major works. 3 units. Nygard and Reiss

315. Studies in Chaucer. 3 units. Nygard and Reiss

318. Medieval Romances. Origins, types, forms, themes; special attention to Arthurian materials. 3 units. Reiss

320. Studies in Renaissance English Prose. Close readings in various forms and authors as they reflect the culture and thought of the Renaissance. 3 units. Lievsay

324. Studies in Shakespeare. Intensive study of carefully limited topics, together with critical analysis and interpretation of selected texts. 3 units. Williams

325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries. 3 units. Randall

329. Studies in the Metaphysical Poets. A careful study of Donne, Herbert, and Vaughan against the seventeenth century background, with some attention to their influence on other writers in the period and their impact on twentieth century poetry. 3 units. Lievsay and Williams

330. Studies in Dryden and His Age. The early poems, the important odes, the religious and political poems, selected critical and controversial prose, and the heroic play and tragedy. 3 units. Jackson

337. Studies in Swift. Intensive study of the major prose; selected readings in the verse, political writings, and miscellaneous prose. 3 units. Ferguson

338. Samuel Johnson's Literary Criticism and Related Topics. 3 units. Ferguson

339. The Eighteenth Century Novel. Richardson, Fielding, Smollett, and Sterne are emphasized. Attention is given to earlier prose fiction and to other contributing literary patterns. 3 units. Ferguson

341. Studies in English Romanticism. 3 units. Clubbe

343. Studies in Coleridge and Carlyle. 3 units.

347. Studies in Victorian Poetry. 3 units. Ryals

348. Studies in Victorian Fiction. 3 units. Ryals

349. Studies in Nineteenth Century Nonfictional Prose. 3 units.

353. Studies in British Poetry of the Twentieth Century. Detailed examination of major poetic texts with background readings in prose. 3 units. Smith

361. Studies in a Major American Author of the Early Nineteenth Century. 3 units. Anderson, Jones, and Turner

362. Studies in a Major American Author of the Later Nineteenth Century. 3 units. Budd and Cady

364. Hawthorne and Melville. Extensive reading in the works of Hawthorne and Melville, and close study of selected writings. 3 units. Jones and Turner

368. Studies in American Realistic Fiction. Intensive study of a post-Civil War novelist such as Howells, with lesser attention to a representative precursor such as De Forest, and a twentieth century writer such as Dreiser. 3 units. Budd and Cady

369. Studies in American Humor. The native tradition in the Down-East humorists and the humorists of the Old Southwest, in Mark Twain and his contemporaries, and afterward. 3 units. Turner

376. Studies in Twentieth Century American Literature. Selected problems posed by the poetry, prose, fiction, or drama of this century. 3 units. Duffey

380. The Traditional Ballad and Folksong. Studies in English, Scottish, and American popular poetry, with attention to the textual and musical traditions. (No technical knowledge of music is required.) 3 units. Nygard

383. Textual Criticism. The principles of analytical bibliography and their application to problems and procedures in the study of Elizabethan printed books. 3 units. Williams

100. English for Foreign Students. A non-credit course which includes an individual tutorial stressing writing and a small class emphasizing conversation and pronunciation. The tutorial is restricted to registered undergraduate and graduate foreign students.

Forestry

Professor Ralston, Dean (213 Biological Sciences Building); Professor Anderson, Director of Graduate Studies (04 Biological Sciences Building); Professors Barnes, Harrar, Hellmers, Knoerr, Kramer, Philpott, and Stambaugh; Associate Professor Yandle; Adjunct Associate Professors Clark, Hodges, Metz, and Vukovich; Assistant Professors Convery and Wuenscher

Major and minor work is offered in the natural and social aspects of forestry and related areas of natural resources leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees. Work for these degrees may be pursued in the biological science areas of dendrology, wood anatomy, forest ecology, tree physiology, biochemistry, forest entomology, and forest pathology; in the environmental science areas of forest soils, meteorology, and hydrology; in resource economics; and in forest mensuration, biometry, and operations research. College graduates who have had specialized training in professional forestry or the related basic areas of the natural or social sciences will be considered for admission. Students will be restricted to the particular fields of specialization for which their academic background qualifies them. For information on professional training in forestry, the *Bulletin of the School of Forestry* should be consulted.

The specific degrees available in forestry and related natural resources through the Graduate School are: the M.A. (with or without a thesis), M.S. (with a thesis), and the Ph.D. Students majoring in forestry may be required to demonstrate satisfactory knowledge of one or two foreign languages for the Ph.D. degree. More information on degree and language requirements can be found in the program information section of the *Bulletin*.

BIOLOGICAL SCIENCE

Dendrology and Wood Anatomy

206. Anatomy of Woody Plants. (Also listed as Botany 206.) 4 units.
Philpott

292. Microtechnique of Woody Tissue. Preparation of wood for microscopic study including sectioning, staining, and mounting techniques; elementary photomicrography. Prerequisites: Forestry 241 and 290 or equivalent. 3 units. Harrar

398. Timbers of the World. A study of the properties of various groups of tropical and temperate zone woods with particular emphasis upon those used in marine construction, and for lumber, plywood decorative paneling, and furniture. Prerequisite: Forestry 290 or equivalent. 2 units. Harrar

Ecology

243. Natural Resource Ecology. An introduction to modern ecology as applied to natural resource management and environmental protection. Emphasis put on the ecosystem as the basic unit of management. Prerequisite: permission of instructor. 3 units. Wuenscher

277. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: an advanced level course in non-market decision-making or Forestry 378 or its equivalent. 1 unit. Convery

341. Ecological Principles in Environmental Management. Discussion of the application of ecological principles to environmental manipulation. Methods of planning and managing human use of ecosystems while avoiding environmental deterioration. Stress put on the biological viewpoint. Prerequisites: general ecology and Forestry 243 or other substantive course work in ecology. 3 units. Wuenscher

345, 346. Natural Resource Ecology—Environmental Management Seminar. Discussion of current ecological and environmental problems and research topics related to the management of natural resources. 1 unit per semester. Staff

347, 348. Natural Resource Ecology—Environmental Management Seminar. Discussion of current ecological and environmental problems and research topics related to the management of natural resources. 1 unit per semester. Knoerr and Wuenscher

354. Quantitative Analysis of Ecological Environmental Systems. (See description under Statistics and Operations Research.)

Entomology

222. Biology of Forest Insects and Diseases. Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work with emphasis on identification and interpretation of forest and wood degradation. 4 units. Anderson and Stambaugh

225. Chemical Aspects of Forest Protection. Chemical aspects of organisms attacking trees and of materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: Forestry 222. 3 units. Barnes

230. Forest Entomology. Identification, biology, and control of insects that cause damage to trees and wood products. Emphasis of diagnosis is on the characteristics of the damage and the stages of the insects responsible. Prerequisite: Forestry 222 or equivalent or consent of instructor. 3 units. Anderson

233. General Entomology. Principles of morphology, physiology, metamorphosis, and taxonomy of insects. Prerequisite: one course in entomology or zoology or consent of the instructor. 4 units. Anderson

331. Toxicology of Insecticides. Study of the physical, chemical, and biological properties of materials used to destroy insects. Formulation, toxicology, and insect physiology as related to insecticide action are emphasized. Prerequisite: one course in entomology; organic chemistry is recommended. 3 units. Anderson

332. Ecology of Forest Insects. The influence of environmental factors on the vital processes of insects with emphasis on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology or consent of the instructor. 3 units or 4 units with laboratory. Anderson

335. Entomological Research Techniques. Problem analyses, scientific writing, and laboratory and field research methods which are especially applicable to entomological problems. 1 unit. Anderson

385. Seminar in Forest Protection. Discussion of current problems in entomology and pathology and evaluation of topical research for protection and control application in forest resource management. Prerequisites: Forestry 223 and 230. 1 unit. Anderson and Stambaugh

Pathology

222. Biology of Forest Insects and Diseases. (See description under Entomology.)

223. Forest Pathology. Infectious and noninfectious diseases of forest trees, and related deterioration of forest products. Field and laboratory study of symptoms, etiology, and control. Prerequisites: Biology 11 and 12 or equivalent. 3 units. Stambaugh

225. Chemical Aspects of Forest Protection. (See description under Entomology.) 3 units. Barnes

321. Phytopathological Technique in Forestry. Fundamentals of phytopathology and their application to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: Forestry 223 or equivalent. 4 units. Stambaugh

322. Microbiology of Forest Soils. Qualitative and quantitative characterization of the microbial populations of forest soils with emphasis on rhizosphere interactions in root pathogenesis and mycorrhizal development; epidemiology of root diseases of trees; principles of control. Prerequisites: Forestry 223; mycology or bacteriology is recommended. 3 units. Stambaugh

385. Seminar in Forest Protection. (See description under Entomology.)

Physiology and Biochemistry

201. Tree Physiology. A general survey of the major physiological processes in trees and other plants, including food synthesis, growth and water relations. Special project and term paper required. Lectures, laboratories, and readings. Prerequisite: permission of instructor. 3 units. Hellmers

205. Tree Growth and Development. Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. 3 units. Barnes

207. Chemistry of Woody Tissues. Composition of wood at the elemental, molecular, and macromolecular levels; both in woody plants and in processed woods. Distribution and properties of main components, and methods of analysis. Prerequisite: organic chemistry or consent of instructor. 3 units. Barnes

208. Physiology of Wood Formation. Processes involved in the growth and development of woody tissues, including internal control mechanisms and effects of environmental stresses on structure and composition. Prerequisites: Forestry 201 and 241 or equivalents. 3 units. Barnes

225. Chemical Aspects of Forest Protection. (See description under Entomology.) 3 units. Barnes

305. Forest Tree Biochemistry. Study of the biological synthesis, function, and degradation of the main biochemical constituents of trees. Emphasis on cellulose and other cell-wall polysaccharides, lignins, terpenes, and phenolics and other extractives. Prerequisites: Forestry 201 and a course in biochemistry. 3 units. Barnes

ENVIRONMENTAL SCIENCE

Soils

261. Forest Soils. Origin, development, and classification of soils with special emphasis on those developed in humid climates; morphological, physical, and chemical properties of soils in relation to growth of trees; effect of forests on soils. Prerequisites: Chemistry 1 and 2, and Physics 1, or equivalents; physical geology, mineralogy, petrology, and analytical chemistry are also desirable. 3 units. Ralston

362. Forest Soil Physics. Analysis of the physical properties of soil related to the growth and development of forest trees. Consideration is given to the significance of soil moisture, temperature, aeration, and structural characteristics in the analysis of forest growth relationships. Prerequisite: Forestry 261. 3 units. Ralston

364. Soil Classification and Mapping. Classification of soils as natural bodies. Mapping of soils, land use classes, and forest site classes; field study will be made of soils in either the coastal plain or mountains. Prerequisite: Forestry 261. 3 units. Ralston

366. Forest Soil Fertility. The relationships of soil fertility factors in the growth of forest trees. Emphasis is placed on the analysis of soil factors related to the mineral nutrition of trees. Prerequisite: Forestry 262; analytical chemistry is recommended. 3 units. Ralston

Meteorology

203. General Meteorology. A general introduction to the science of meteorology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of atmospheric thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. 3 units. Vukovich

204. Microclimatology. Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. 3 units. Knoerr

215. Air Pollution Meteorology. The theory of transport and diffusion of air pollutants and its application to practical problems and computations involving both single sources and multiple sources, including urban communities; modeling of transport and diffusion, both in wind tunnels and computers; stack design from the meteorological point of view; the organization of meteorological networks and field studies; the measurement, monitoring and equipment requirements of pertinent meteorological parameters; air pollution climatology; meteorological management of air pollution. Prerequisite: introductory course in general meteorology (Forestry 203 or equivalent). (Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty from North Carolina State University.) 3 units. Staff

217. Environmental Instrumentation. Consideration of the physical basis for measuring parameters of natural and controlled environments. Properties and effective utilization of contemporary electronic measurement and data acquisition systems, including transducers, signal conditioners, and analog and digital recorders. Methods for obtaining and processing computer compatible records. Precision measurement and calibration techniques with primary and secondary laboratory standards. Two lectures and three laboratory hours per week. Prerequisites: consent of the instructor; students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. 3 units. Knoerr

304. Atmospheric Turbulence and Diffusion. Bulk and molecular aspects of atmospheric turbulence. Navier-Stokes equations and the Reynold's stresses. Mixing-length and statistical turbulence theories. Similarity hypotheses. Turbulent transfer and diffusion in adiabatic and diabatic atmospheres. Characteristics of turbulence in various scales of motion from the planetary to sub-inertial range. Prerequisites: Forestry 203 and differential equations or consent of instructor. (Offered on sufficient demand.) 3 units. Vukovich

306. Dynamics of Local Atmospheric Motion. Characteristics of atmospheric motion in the 100 m to 100 km scale. Analytic development from hydrodynamic and thermodynamic equations, incorporating appropriate scale

forcing functions of heating and terrain roughness. Theory and characteristics of land and sea breezes, mountain and valley breezes, mountain waves and local modification of large scale atmospheric motion. Prerequisites: Forestry 203 and differential equations or consent of instructor. (Offered on sufficient demand.) 3 units. Vukovich

344. Micrometeorology. Physics of the earth's surface environment with emphasis on plant and animal microclimates: budgets of mass, momentum and energy; vertical structure of wind, temperature, water vapor and carbon-dioxide in relation to exchange processes within the biosphere; local circulation and eddy diffusion; principles of micrometeorological measurement. Prerequisites: Forestry 203 or equivalent, and calculus. (Offered on sufficient demand.) 4 units. Knoerr

Hydrology

216. Watershed Hydrology. Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of streams. Techniques and research methods used to control the hydrologic cycle, water quality and water yield on wild lands. 3 units. Hellmers

342. Hydrologic Processes. Physical processes of the hydrologic cycle with emphasis on those processes which can be modified or controlled by watershed management. (Offered on sufficient demand.) 3 units. Knoerr

RESOURCE ECONOMICS AND POLICY

269. Resource Economics and Policy. Development and critical review of concepts useful in understanding and evaluating the distribution of natural resource use over time in terms of the relations between technological knowledge, group and individual behavior, and social institutions. 3 units. Convery

270. Economics of Forestry. Development of the principles of economics useful in the analysis of the past, present, and prospective supply and demand situations for forestry goods and services: problems of the economics of the firm and industry, basic and peculiar to forestry, with special attention to the time dimensions of value; the role of forestry in the general economy including attention to relevant institutional factors. Prerequisite: Forestry 269 or one course in the principles of economics. 3 units. Convery

273. Economics and Environmental Quality. Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. 3 units. Convery

277. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: an advanced level course in nonmarket decision-making or Forestry 378 or its equivalent. 1 unit. Convery

378. Seminar in Forest Economics. Examination and discussion of the application of economic concepts in forestry, the potential contribution of economic analysis to private and public forest management; current research in forest economics. Prerequisites: Forestry 270 and 379 or consent of the instructor; advanced courses in economics and economic theory are desirable. 2 units. Convery

STATISTICS AND OPERATIONS RESEARCH

210. Analytical Techniques in Forest Utilization. Introduction to utilization in the managed forest and principal wood-using industries and to operations analysis methods applied to scheduling and production problems in these industries. 3 units. Yandle

250. Biometry Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision-making with experimental data. 3 units. Yandle

251. Theory and Methods for Sampling Biological Populations. Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: Forestry 250 or consent of instructor. 3 units. Yandle

253. Computer Science in Natural Resources. Components and organization of a computer system; automatic programming languages; storage and retrieval systems (TSAR); equation fitting by iteration and least squares methods; graphical techniques. 1 unit. Staff

258. Operations Research. Mathematical model formulation and development of techniques to aid decision-making in problems of natural resource allocation and use. Includes the theory and techniques of inventory control, equipment replacement planning, queuing theory, competitive strategies, allocation, sequencing and dynamic programming. Consideration is given to both deterministic and non-deterministic models. 3 units. Staff

352. Theory and Applications of Linear Statistical Models. Theoretical development of the general linear statistical model together with extensions to accommodate linear approximation of non-linear cases. Curve fitting techniques are developed with emphasis on applications to natural phenomena. Prerequisite: consent of the instructor. 3 units. Staff

353. Design and Analysis of Experiments. Extension of the theory of estimation and testing for general linear models to include the less than full rank case. Experimental design models such as factorial and incomplete block models are developed as special cases of the general theory. Emphasis is placed on field and laboratory designs together with appropriate computerized analysis techniques. Prerequisite: Forestry 352. 3 units. Staff

354. Quantitative Analysis of Ecological and Environmental Systems. Study of quantitative methods for describing forest ecosystems. Analysis of characteristics and dynamic behavior of biological populations; development and evaluation of mathematical models for ecological, physiological, and environmental systems. Simulation techniques for ecosystem analysis will be considered. Prerequisites: Forestry 204, 243, 253, and 353. 3 units. Yandle and Staff

SPECIAL STUDIES AND RESEARCH

299. Special Studies in Forestry. Work on the senior-graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. Staff

301, 302. Advanced Studies in Forestry. Work on the advanced graduate level to meet the needs of individual students offered in the areas of

forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. Staff

357, 358. Research in Forestry. Students with adequate training may undertake special research problems under direction of members of the faculty in the following branches of forestry and related natural resources. Credits to be arranged.

1. Forestry Ecology. Prerequisite: Forestry 243 or equivalent. Wuenscher
2. Forest Soils. Prerequisite: Forestry 261 or equivalent. Rolston
3. Silviculture. Prerequisites: Forestry 243 and 244 or equivalents. White
4. Forest Management. Prerequisite: Forestry 281 or equivalent. Stoff
5. Forest Economics. Prerequisite: Forestry 270 or equivalent. Stoff
6. Wood Anatomy and Properties. Prerequisites: Forestry 241 and 290 or equivalents.

Horror

7. Forest Mensuration and Biometry. Prerequisites: Forestry 250 and 352 or equivalents.

Chapman

8. Forest Entomology. Prerequisite: Forestry 230 or equivalent. Anderson
9. Forest Operations Research. Prerequisite: consent of instructor. Yonelle
10. Dendrology. Prerequisite: Forestry 241 or equivalent. Horror and White
11. Forest-Tree Physiology. Prerequisites: plant physiology and plant or forest ecology. Barnes, Hellmers, and Kramer
12. Forest Pathology. Prerequisites: plant physiology and Forestry 223 or equivalents.

Stombough

13. Forest Meteorology and Hydrology. Prerequisites: Forestry 203, 342, or equivalents. Knoerr
14. Forest Biochemistry. Prerequisites: plant physiology and organic chemistry. Barnes

368. Field Seminars. Field studies, consultations, and visits to areas of interest during spring vacation period or at other times, in the several branches of forestry and related natural resources listed under Forestry 357, 358. Credits to be arranged. Staff

RELATED COURSES IN OTHER DEPARTMENTS

Many courses available in other departments of the University are related to the biological, environmental, economics and policy, and biometrics and operations research areas of forestry and other natural resources. These courses offered in botany, zoology, biochemistry, chemistry, physics, engineering, mathematics, economics, business administration, sociology, and political science may be utilized by graduate students in the School of Forestry. For a specific listing of pertinent courses available in other departments see the Bulletin of the School of Forestry.

The University Program in Genetics

Professor Gross, Director (Biochemistry); Professors Amos (Microbiology and Immunology) and Guild (Biochemistry); Associate Professors Antonovics (Botany); Boynton (Botany), Gillham (Zoology), Kelley (Biochemistry), C. Ward (Zoology), and Webster (Biochemistry); Assistant Professors Hall (Biochemistry), Harriman (Biochemistry), Kredich (Biochemistry), and F. Ward (Microbiology and Immunology)

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. It would be helpful if applicants for admission to the Graduate School indicated their interest in the genetics program at the time of application. Requests for information describing more completely the research interests of the staff, facilities, and special stipends and fellowships should be addressed to the Director, Genetics Program (Nanaline H. Duke Building, Room 151).

For Seniors and Graduates

204. Introductory Genetics. An introduction to genetic analysis with emphasis on the molecular basis of mutation, segregation, function, and organization of the genetic material. Primarily for medical students but graduate students may be admitted with the instructor's permission. (Listed as Biochemistry 204.) 2 units. Gross and Staff

216. Molecular Genetics. An advanced course on genetic mechanisms and their relationship to nucleic acids. Prerequisites: introductory courses in biochemistry and genetics. (Also listed as Biochemistry 216.) 3 units. Guild and Staff

280. Principles of Genetics. An introduction to the structure and properties of genes and chromosomes and to the evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics. (Also listed as Botany 280 and Zoology 280.) 3 units. Antonovics, Boynton, and Gillham

282. Experimental Genetics. A series of laboratory exercises and discussions on the molecular mechanisms of mutation, recombination, replication, transcription, and translation of the genetic material. May be taken concurrently with Genetics 280. Prerequisite: consent of instructor. (Also listed as Biochemistry 282.) 2 units. Harriman and Staff

284. Current Topics in Genetic Mechanisms. A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in response to adequate demand. Prerequisites: Genetics 280 or its equivalent and consent of instructor. (Also listed as Biochemistry 284.) 1 unit. Hall and Staff

285. Population Genetics. A seminar and lecture course devoted to the analysis of the current literature in population genetics and evolution. Prerequisites: Genetics 280 or its equivalent and consent of the instructor. (Also listed as Botany 285.) 2 units. Antonovics and Staff

286. Evolution. Processes of adaptation and evolution in individuals, populations, and genetic systems. (Also listed as Zoology 286.) Not open to students who have had courses previously numbered Zoology 109 or Botany 240. Prerequisite: a course in genetics or consent of the instructor. 3 units. Antonovics, Lundberg, and H. Wilbur

288. The Cell in Development and Heredity. A seminar on topics of current interest and controversy. Prerequisites: a course in genetics and permission of one instructor. Alternates with Anatomy 244 and Zoology 244. (Also listed as Anatomy 288 and Zoology 288.) Counce, Gillham, and Staff

For Graduates

336. Immunogenetics. Antigens of tissues and organs, distribution, extraction, and chemistry. Phylogeny of iso-antigenic systems of man and animals. Test for histocompatibility including lymphocyte interaction and reactivity. Change in antigenicity and immune responsiveness in carcinogenesis. Immunologic factors in pregnancy and in homotransplantation of organs. (Also listed as Microbiology and Immunology 336.) 2 units. Amos and Ward

351-352. Genetics Seminar. Required of all students specializing in genetics. (Also listed as Biochemistry 351-352.) 1 unit per semester. Harriman and Staff

Geology

Professor Heron, Chairman (119 Science Building); Associate Professor Perkins, Director of Graduate Studies (111 Science Building); Professor Pilkey; Associate Professors Furbish and Lynts; Lecturer Shuart

The Department of Geology offers graduate work leading to the M.S. degree. An undergraduate degree in geology is not a prerequisite for graduate studies, but a student must have had or must take a summer field geology course (or equivalent experience), mineralogy, sedimentary rocks, stratigraphy, paleontology, and structural geology. In addition he must have had one year of college chemistry, one year of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide specialized training in the fields of oceanography, sedimentology, stratigraphy, paleontology, and low-temperature mineralogy.

An acceptable thesis is required. There is no language requirement for the M.S. degree.

For Seniors and Graduates

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary process. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. This course is not open to students who have completed Geology 206. (Given at Beaufort only.) 6 units. Pilkey

206. Principles of Geological Oceanography. A broad survey of many geological aspects of the oceans including sediment types, processes of sedimentation, geological structures of the ocean basins, and bottom physiography. Prerequisite: Geology 213 or consent of instructor. 3 units. Pilkey

208. Shallow-Marine Geology. Physical and biological processes responsible for sediment production, accumulation, and alteration in the shallow-marine environment. Prerequisite: Geology 108 or consent of instructor. 3 units. Perkins

211. Stratigraphic Principles and Applications. Survey of stratigraphic principles with an emphasis on their application to the solution of stratigraphic problems. Discussions of case histories from the literature. Prerequisite: Geology 108. 3 units. Perkins

213. Sedimentology. The parameters of sedimentation, sediment classification, and laboratory methods of analysis. Prerequisite: Geology 108 or consent of instructor. 3 units. Pilkey

214. Sediments in Thin Section. The study of sediments and sedimentary rocks using the petrographic microscope and related techniques. Interpretation of rock textures and their genesis will be emphasized. Prerequisite: Geology 213 or consent of the instructor. 3 units. Perkins

222. Sedimentary Minerals. Structure and geologic occurrences of selective detrital and authigenic minerals including the clay minerals. Theory and use of X-ray diffraction, differential thermal analysis, and thermal gravimetric analysis. Prerequisite: Geology 102 or consent of instructor. 3 units. Heron

***229. Economic Geology.** An analysis of the principles and processes involved when elements are concentrated to economic proportions in mag-

*Offered on demand.

matic, metamorphic, hydrothermal, sedimentary, or surface environments. Prerequisites: Geology 102. 2 units. Furbish

230. Principles of Structural Geology. Description, origin, and interpretation of primary and secondary geologic rock structures. Prerequisites: Geology 106 and 108. Given biennially. 3 units. Shuart

233. Geochemistry. Application of the principles of chemistry to the solution of problems in geology. Prerequisites: Geology 102 and Chemistry 12. 3 units. Shuart

241-242. Invertebrate Paleontology. Biologic and stratigraphic relationships of fossil invertebrates, with special emphasis on evolutionary trends of invertebrates as interpreted from fossil evidence. Prerequisite: Geology 2 or consent of instructor. Given biennially. 3 units per semester. Lynts

243-244. Micropaleontology. Microscopic animal and plant fossils, exclusive of spores and pollen, with special emphasis on their biology, taxonomy, evolution and stratigraphic distribution. Prerequisite: Geology 242 or consent of instructor. Given biennially. 3 units per semester. Lynts

247. Paleoecology. Application of ecologic and geologic principles to the reconstruction of the interrelationship between organisms and their environment in geologic time. Prerequisites: Geology 213, 242 or consent of instructor. Given biennially. 3 units. Lynts

For Graduates

***300. Seminar in Oceanography.** 1 to 3 units. Staff

305. Seminar in Continental Drift and Global Tectonics. Given biennially. 3 units. Lynts

***310. Seminar in Stratigraphy.** 1 to 3 units. Staff

***312. Seminar in Sedimentology.** 1 to 3 units. Staff

***320. Seminar in Mineralogy.** 1 to 3 units. Staff

***330. Seminar in Geochemistry.** 1 to 3 units. Staff

***340. Seminar in Paleontology.** 1 to 3 units. Staff

***350. Seminar in Geomathematics.** 1 to 3 units. Staff

***371, 372. Advanced Topics in Geology.** To meet the individual needs of graduate students for independent study in various environmental sedimentary fields. 1 to 3 units. Staff

Germanic Languages and Literature

Professor Phelps, Chairman and Director of Graduate Studies (102 Foreign Languages); Professor Salinger; Associate Professor Borchardt; Assistant Professors Alt, Novak, and Stern

The Department of Germanic Languages and Literature offers graduate work leading to the A.M. degree. Students who expect to major in German should have had sufficient undergraduate courses in Germanic languages to enable them to proceed to more advanced work.

Students who wish to take courses in German as a related field should normally have completed a third-year course (in exceptional cases, a second-year) of college German with acceptable grades.

For Seniors and Graduates

201, 202. Goethe. A study of his life and works in the light of his lasting

*Offered on demand.

significance to Germany and world literature. First semester: lyrics, prose fiction, and selected dramas; second semester: *Faust*, I and II. 3 units per semester. Novak, Phelps, and Salinger

203, 204. Eighteenth Century. Eighteenth century German literature in its relation to European intellectual currents of that time. 3 units per semester. Phelps

***205, 206. Middle High German.** The language and literature of Germany's first classical period. 3 units per semester. Stern

***207, 208. German Romanticism.** The principal writers of the period of German Romanticism from 1800 to 1850. 3 units per semester.

209, 210. Kleist, Grillparzer, and Hebbel. The development of the drama in Germany and Austria between Schiller and Naturalism. 3 units per semester. Alt and Salinger

211, 212. Nineteenth Century Literature. From the end of Romanticism through Realism. 3 units per semester. Alt

213. Heinrich Heine. A study of the German poet and his impact upon his age. 3 units. Salinger

214. The Twentieth Century. Literature from the turn of the century to the present through representative authors. 3 units.

***215. Seventeenth Century Literature.** A study of the leading writers of the Baroque, viewed against the background of their time. 3 units. Borchardt

216. History of the German Language. The development of the phonology, morphology, and syntax of German from earliest beginnings to the present. 3 units. Stern

***217. Renaissance and Reformation Literature.** The period from 1400 to about 1600. 3 units. Borchardt

***218. The Teaching of German.** A survey of modern teaching techniques: problems in the teaching of German on the secondary and college levels. Analysis and evaluation of textbooks and related audiovisual materials. 3 units. Phelps

***219. Applied Linguistics.** The application of modern linguistic principles to a systematic study of the phonetics, morphology, and syntax of modern German. Prerequisite: permission of the instructor. 3 units. Stern

***222. Criticism and Literary Theory.** Critical concepts, craft of interpretation, and readings from the great critics. 3 units. Alt and Borchardt

***223. Advanced Composition.** Intensive study of syntax; practice in the writing of German prose, aiming toward the development of an expressive and fluent style. 3 units.

For Graduates

***301. Gothic.** 3 units. Stern

***316. The Austrian Novel from 1930 to the Present.** Studies in the novels of Hermann Broch, Robert Musil, and Heimito von Doderer. 3 units. Salinger

321, 322. Germanic Seminar. 3 units per semester. Alt, Phelps, Salinger, and Stern

_____. **Graduate Reading Course.** An intensive course in German to develop rapidly the ability to read German in several fields. Graduate students only. No credit.

*Offered on demand.

Related Courses in Other Departments

The following courses in other departments are recommended to students who are majoring in Germanics, as particularly valuable in building a proper background for Germanic studies.

a. Graduate courses in foreign or comparative literature or philology, offered by the ancient and modern language departments, to be selected after consultation with the Germanic Languages Department.

b. Graduate courses in history and philosophy, offered by those departments, to be selected after consultation with the Germanic Languages Department.

Health Administration

Associate Professor Jaeger, Chairman (263 Baker House); Assistant Professor Smith, Director of Graduate Studies (243-B Baker House); Professor Sessoms; Associate Professors Minniear and Swanson; Adjunct Associate Professor Coulter; Adjunct Assistant Professors Kaluzny and Peck; Lecturer Steinert

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-one-month academic program that leads to the M.H.A. degree. The academic portion is composed of five continuous semesters of graduate work of which 36 units are within the department, 39 units are in other departments of the Graduate School (30 of these units are in courses offered through the Graduate School of Business Administration). Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests. For students without previous administrative experience, the residency should be considered an integral part of the M.H.A. program. Admission to this program is based upon suitability of the candidate to assume leadership roles in the organization and management of the delivery of health services, as well as on capability for graduate study. As requirements for participation differ somewhat from the basic admission requirements of the Graduate School, interested individuals should obtain complete information about the program directly from the Chairman.

201. The Health System and Its Environment. An introduction to the organization and management of health services from a systems perspective. Emphasis is on the evolution of the present system and on the interplay of forces within the system and between the system and its environment. 3 units.

312. Comparative Health Systems. A comparative examination of the structure and performance of the health systems of the United States and other countries, particularly Canada and Great Britain. Topics include current financing, capitalization, utilization, control, and the relative roles of the governmental and private sectors. 3 units.

322. Public Policy and Health Care. A study of the development and present status of selected public policy issues within their social, economic, and political contexts. Alternative courses of possible public action are reviewed and their probable outcomes are assessed. 3 units.

324. Institutional Health Services. A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other

long-term care institutions. Specific study is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; the planning function; and the evaluation of performance. 5 units.

329-339-349. The Clerkship. The clerkship is designed to provide the students an opportunity to experience and develop perspective on the interplay of various forces and problems within the field of health services delivery. Each student rotates through six different settings that are selected as focal points for significant combinations of people, problems, and resources. Within each setting the student, under faculty supervision, is responsible for the conduct of certain administrative functions in order to increase his ability to solve real problems and improve personal judgment. 1-2 units each in the summer, fall, and spring semesters.

335. Ambulatory Health Services. This course covers the noninstitutional components of the organization and provision of personal health services. The principal emphasis is on medical group management, including forms of organization, financing of services, physician-patient relationships, medical records, and peer review. Other topics include dental care, home care, halfway houses, multiphasic screening, and community health and mental health centers. 3 units.

346. Community Health Services. The focus of this course is the organization and management of health services directed toward general populations rather than individuals. Coverage includes aspects of environmental and occupational hygiene, nutrition and housing, planning community health services, preventive health education and programs, and other public health activities. Included are the problems associated with health status measurements and assessment. 3 units.

348. Legal and Regulatory Constraints on Health Services. This course treats the legal relationships between elements of the health system and the larger society of which it is a part. Attention is devoted to the certification, operation and performance of health manpower, organizations, and services, and the difficulties in establishing effective restraints to minimize undesired results. The approach to the course includes the study of selected legislation, court cases, and research findings that assist in understanding formal constraints that affect the operation of the health system. 2 units.

350. The Administrative Residency (Basic). The basic administrative residency is a period of training that is individually designed and provides a significant set of participatory experiences in various components of the health care system. The two purposes of the residency are to broaden the student's knowledge of the actual operation of the system and to further improve the student's ability to utilize in real settings the skills developed during the academic phase of training. 4 units.

355. Administrative Residency (Special). Available only to students in joint-degree programs. This training is similar to that received in HA 350. 1 unit.

360. Seminar in Health Administration. A series of seminars held at the end of each quarter during the administrative residency. The seminars are designed to complement the experience obtained during the residency and to add depth to the material covered during the academic phase of the program. Credits to be arranged. 2 units.

371, 372. Directed Research. Credits to be arranged.

380. Administrative Residency (Advanced). This traineeship represents an optional experience available to the student with special professional objectives. 2 units.

History

Professor Colton, Chairman (235 Allen); Professor Young, Director of Graduate Studies (237 Allen); Professors Alden, Durden, Ferguson, Holley, Hollyday, Lerner, Oates, Parker, Preston, Ropp, A. Scott, W. Scott, Silberman, TePaske, and Watson; Associate Professors Acomb, Brieger, Cell, Davis, Hartwig, Mauskopf, Nathans, and Witt; Assistant Professors Bergquist, Calkins, Chafe, Dirlk, Gavins, Goodwyn, and Miller

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. The candidate for the A.M. degree must have a reading knowledge of at least one ancient or modern language related to his program of study and have completed successfully either a research paper (approximately fifty to sixty documented pages) or two related, chapter-length papers (approximately twenty-five to thirty documented pages each), normally the product of a year's seminar or two semester-courses. The paper or papers must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and approved by April 15; those anticipating a September degree must have their papers read and approved by August 15.

A candidate for the degree of Doctor of Philosophy is required to prepare himself for examination in four fields. Three usually shall be history. The choice of fields is determined in consultation with the student's supervisor and the Director of Graduate Studies. The department offers graduate instruction in the fields of Africa, Afro-American history, ancient history, medieval and early modern Europe, modern Europe, American history, Britain and the Commonwealth, Imperial Russia, modern Russia, Latin America, South Asia, traditional China, modern China, traditional Japan, modern Japan, military history, history of science, and history of medicine. The candidate for the Ph.D. degree usually must have a reading knowledge of two foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative usually would take the form of successfully completed formal training in an auxiliary discipline (such as statistics or a course in one of the other social sciences with an emphasis upon methodology) of from 3 to 6 units, or their equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

Students may receive credit for either semester of a hyphenated course without taking the other semester if they obtain written permission from the instructor and the Director of Graduate Studies.

For Seniors and Graduates

201-202. History of Russia, 1801-1917. Origins and dynamics of the Russian revolutionary movement, the intelligentsia, and the emergence of political parties. 6 units. Miller

207-208. Urban History of the United States. Urbanization in the United States since the Colonial period. Each student is responsible for the history

of a particular city, with attention to the emerging methodology of urban studies. 6 units. A. Scott

209-210. Selected Topics in Afro-American History, 1619-Present. Critical issues of the collective experience of Afro-Americans with special attention to Black institutional development. 6 units. Gavins

212. Recent Interpretations of United States History. A course designed to encourage a critical evaluation of major issues in United States history through examination of recent interpretations of key problems. (Offered in double class meetings during the first half of the spring semester.) 3 units. Watson and Staff

215-216. The Diplomatic History of the United States. 3 units per semester. Davis

221-222. Problems in the History of Late Medieval and Early Modern Europe. 6 units. Witt

223, 224. The Old Regime, the Enlightenment, and the French Revolution. Political, social, and intellectual trends in seventeenth and eighteenth century Europe, with emphasis on France and the French Revolution. 6 units. Acomb

227-228. Recent U.S. History: Major Political and Social Movements. 6 units. Chafe

229. Recent Interpretations of Modern European History. A course designed to develop the ability to appraise critical historical issues through the study and discussion of recent interpretations of key historical problems in modern European history. 3 units. Colton and Parker

231, 232. Problems in the History of Spain and the Spanish Empire. 3 units per semester. TePaske

237, 238. Europe in the Middle Ages, 395-1500. 3 units per semester. Young

240. Aspects of Traditional and Modern African Culture. Introduction to the oral and written literatures and the musical and artistic traditions. 3 units. Hartwig

241-242. Modernization and Revolution in China. 6 units.

247. History of Modern India and Pakistan, 1707-1857. Analysis and interpretation with special emphasis on changes in social and economic life. 3 units.

248. History of Modern India and Pakistan, 1857 to the Present. 3 units.

249-250. Social and Intellectual History of the United States. The interplay of ideas and social practice through the examination of attitudes and institutions in such fields as science and technology, law, learning, and religion. 6 units. Holley

253-254. Modern European Intellectual History. 6 units. Parker

255-256. Problems in African History. 6 units. Hartwig

261-262. Problems in Soviet History. Studies in the background of the Revolution of 1917 and the history and policies of the Soviet state. 6 units. Lerner

263-264. American Colonial History and the Revolution, 1607-1789. The founding and institutional development of the English colonies; the background, progress, and results of the Revolution. 6 units. Alden

265, 266. Problems in Modern Latin American History. 3 units per semester. Bergquist

267-268. From Medieval to Early Modern England. The intellectual, social, and political problems of the transition to modern England, with special emphasis on the English Renaissance. 6 units. Ferguson

269-270. British History, Seventeenth Century to the Present. Historiography of social structure and social change: English Revolution, party, the Industrial Revolution, class and class-consciousness, Victorianism, and the impact of war in the twentieth century. 6 units. Cell

273-274. Topics in the History of Science. Studies of critical stages in the evolution of scientific thought as well as of their intellectual context. 3 units per semester. Mauskopf

275-276. Central Europe, 1849-1914. 3 units per semester. Hollyday

277, 278. The Era of the Civil War in the United States and Its Aftermath, 1820-1900. 3 units per semester. Durden

279. Oral History. Techniques of oral history applied to the study of racial attitudes and problems in the United States. 3 units. Goodwyn

280. Historiography. Great historians since Herodotus and an examination of recent twentieth century trends. 3 units. Staff

281, 282. Development of Modern Medicine. 3 units per semester. Brieger

283-284. Political and Social Change in the United States, 1789-1860. 3 units per semester. Nathans

287-288. History of Modern Japan. Political, economic, and social development of Japan since 1750 with emphasis on factors contributing to Japan's emergence as a modern state. 3 units per semester. Silberman

296. Canada from the French Settlement to the Present. Selected problems in the development of Canada and its provinces. 3 units. Preston

297. The British Empire in the Nineteenth Century (from 1783). The development of the Empire from the American Revolution to the imperialism that culminated in the South African War. 3 units. Preston

298. The Commonwealth in the Twentieth Century. The origins and evolution of the Commonwealth of Nations and its adjustment in the age of anti-colonialism. 3 units. Preston

ANCIENT HISTORY

For courses in ancient history which may be taken for credit in either history or classical studies, see Classical Studies.

For Graduates

305-306. Seminar in British History. 3 units per semester. Ferguson

307-308. Seminar in United States History. 3 units per semester. Davis, Durden, Holley, and Watson

309-310. Seminar in American Colonial and Revolutionary History. 3 units per semester. Alden

317-318. Seminar in the History of Western Europe. 3 units per semester. Colton, Parker, and Scott

337-338. Seminar in Medieval History. 3 units per semester. Young

343-344. Seminar in the History of American Foreign Relations. 3 units per semester. Davis

347-348. Seminar in Modern India. 3 units per semester.

353-354. Seminar on the Second British Empire and the Commonwealth of Nations. 3 units per semester. Preston

361-362. Seminar in the History of Russia. 3 units per semester.

371-372. Research Seminars. Offered in conjunction with colloquia listed below. 3 units per semester.

401. Seminar on the British Commonwealth. 3 units. Ball, Preston, and Others of the Committee on Commonwealth Studies

Colloquia for Graduates

Each colloquium described below deals with an aspect of history by means of readings, oral and written reports, and discussion, with attention to bibliography. In some instances, students may take the equivalent of a research seminar in conjunction with the colloquium and will be credited with an additional 6 units by registering for 371.1-372.1, etc.

351.1-352.1. Military History. 3 units per semester. Ropp

351.2-352.2. Modern European Intellectual and Cultural History. 3 units per semester. Parker

351.10-352.10. Medieval Europe. 3 units per semester. Young

351.15-352.15. The English Renaissance. 3 units per semester. Ferguson

351.25-352.25. Central Europe, 1849-1914. 3 units per semester. Hollyday

351.30-352.30. European Diplomatic History Since 1870. 3 units per semester. W. Scott

351.31-352.31. Twentieth Century Europe. 3 units per semester. Colton

351.40-352.40. City and Frontier in United States History. 3 units per semester. A. Scott

351.45-352.45. Reform and Politics in Nineteenth Century America. 3 units per semester. Durden

351.46-352.46. Twentieth Century United States to 1941. 3 units per semester. Watson

351.47-352.47. Diplomatic History of the United States. 3 units per semester. Davis

351.51-352.51. Hispanic America. 3 units per semester. TePaske

351.60-352.60. Soviet History. 3 units per semester. Lerner

351.65-352.65. Modernization and Revolution in China. 3 units per semester.

351.70-352.70. Modern South Asia. 3 units per semester.

351.74-352.74. American Colonial History and the Revolution. 3 units per semester. Alden

Historiography and the Teaching of History—For Graduates

312. Seminar in the Teaching of History in College. The work in this course is intended to acquaint students with the problems involved in teaching history in college. It includes classroom observation and some teaching experience. Required of all candidates for the degree of Doctor of Philosophy who are in residence for two years at Duke. Year course. No credit. Holley and Watson

314. Historical and Social Science Methodology. Methods used in histori-

cal research with emphasis upon the various social science approaches. 3 units. Chafe and Silberman

History 314 or History 280 is required of all candidates for the Ph.D. degree who are in residence for two years at Duke University.

Marine Sciences—The University Program

Professor Costlow, Director; Professors Bookhout (Zoology), Johnson (Botany), and Pilkey* (Geology); Associate Professors Barber (Zoology and Botany) and Searles* (Botany); Assistant Professors Baier (Chemistry), Blankley (Botany), Forward (Zoology), Gutknecht (Physiology), Sullivan (Biochemistry), and Sutherland (Zoology)

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are Botany, Chemistry, Geology, and Zoology.

A graduate student working in the marine sciences will take his degree under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of his training he will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of his course work and preliminary examination (for doctoral candidates) he may, with approval of his major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.

Applications for summer courses at the Laboratory should be addressed to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the Duke University Marine Laboratory Bulletin. The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received before March 10.

Students registering for research should do so under the appropriate departmental numbers.

The following courses are offered during the summer at Beaufort. See the Duke University Marine Laboratory Bulletin for the current schedule of courses.

S202. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lecture and laboratory. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. Salmon (University of Illinois)

203. Marine Ecology. Ecological processes as exemplified by marine organisms; environmental factors, intra- and inter-specific relationships; community ecology. Readings, discussions, written papers, and computer use. Field projects using modern methods. Prerequisites: a course in general biology, invertebrate zoology, or the equivalent, and a year of mathematics; some knowledge of statistics will be helpful. (Given at Beaufort.) (Listed as Zoology 203.) 6 units. Sutherland

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary process. Observations in the field will be empha-

*In residence at the Marine Laboratory during the summer only.

sized and will include training in sampling procedures for both shallow and deep water. This course is not open to students who have completed Geology 206. (Given at Beaufort only.) (Listed as Geology 205.) 6 units. Pilkey

204. Introductory Marine Microbiology. The biology of microorganisms in oceans and estuaries. Prerequisite: one year of college biological science. (Listed as Botany 204.) 6 units. Johnson and Searles

211. Marine Phycology. An introduction to marine algae: their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. (Listed as Botany 211.) 6 units. Searles

212. Membrane Physiology and Osmoregulation. Physiology of aquatic organisms, with emphasis on cellular transport and electrophysiological processes. Includes lectures and laboratory work on the mechanisms and comparative aspects of ionic and osmotic regulation in plants and animals. (Given at Beaufort.) Prerequisite: permission of instructor. (Listed as Physiology 212.) 6 units. Summer. Gutknecht, Wachtel, and Staff

214. Biological Oceanography. Composition in time and space of marine biosphere in relation to descriptive marine chemistry, physics, and geology. Some work at sea aboard the research vessel. Prerequisite: chemical oceanography or permission of instructor. (Given at Beaufort.) (Listed as Zoology 214.) 6 units. Barber

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry (Chemistry 160 and 161 or equivalent), statistics (Math. 183 or equivalent), or permission of instructor. (Given at Beaufort.) Includes lectures, laboratory work, and field trips. (Listed as Chemistry 240.) 6 units. Baier

250. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Given at Beaufort.) (Listed as Zoology 250.) 6 units. Forward

274. Marine Invertebrate Zoology. Structure, functions, and habits of invertebrate animals under normal conditions and experimental conditions. Field trips will be made to study, collect, and classify animals in their natural habitats. Prerequisite: college biology. (Given at Beaufort.) (Listed as Zoology 274.) 6 units. Staff

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. (Given at Beaufort.) (Listed as Biochemistry 276.) 6 units. Staff

S277. Endocrinology of Marine Animals. Control of growth, regeneration, reproduction, metabolism, and other aspects of physiology of marine animals, primarily invertebrates. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. Hagadorn (University of North Carolina)

S278. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. (Given at Beaufort.) 6 units. Bookhout

Mathematics

Professor Warner, Chairman (135C Physics Building); Associate Professor Burdick, Director of Graduate Studies (135D Physics Building); Professors Carlitz, Dressel, Murray, Reed, Shoenfield, and Weisfeld; Associate Professors Hodel, Kitchen, Kraines, Moore, Scoville, Smith, and Stackelberg; Assistant Professors Lees, MacKichan, O'Fallon, and Wong

Graduate work in the Department of Mathematics is offered leading to the M.S. and A.M., and Ph.D. degrees. The student, in his undergraduate work, must have had courses in differential and integral calculus, and at least 6 semester hours of other courses in mathematics on the junior or senior level.

The department offers a program in applied statistics with a minor in computer science leading to the M.S. degree. The program consists of 24 units of graded course work plus a thesis project involving the use of the computer.

All A.M. and Ph.D. degree candidates are required to pass a comprehensive examination in the areas of algebra, analysis, and topology. Students will usually take the comprehensive examination after completing their first year of graduate study and just prior to the start of their second year.

The A.M. degree with a major in mathematics is awarded primarily on the basis of scholarship. It requires 30 units of graded course work in addition to the comprehensive examination. A thesis may be substituted for 6 units of course work only in unusual circumstances.

The Ph.D. degree in mathematics is awarded upon the demonstration of ability and training in research. The original dissertation, therefore, is the most important of the formal requirements for the degree.

All A.M. and Ph.D. degree candidates are expected to participate in a proseminar during their first year of graduate study. The purpose is to provide experience in organizing and presenting material to their peers.

Since a reading knowledge of French, German, and Russian is highly desirable for a student of mathematics, the Ph.D. degree candidate should satisfy the language requirement in two of these languages as early as possible. The department offers departmentally administered language examinations as an alternative to the ETS examinations.

For Seniors and Graduates

204. Geometry for Teachers. Metric and synthetic approaches to plane and solid geometry; affine geometry; an algebraic model of Euclidean geometry. 3 units. Staff

206. Introduction of Stochastic Processes. Elementary theory and application of stochastic process models; Poisson processes, counting processes, discrete parameter Markov chains. Prerequisite: Mathematics 135. 3 units. Staff

207, 208. Introduction to Algebraic Structures. Groups, rings, fields; isomorphism theorems; partial and total orderings; characterizations of basic number systems; permutation groups; finitely generated Abelian groups; polynomial rings; principal ideal domains; division and Euclidean algorithms; vector spaces; linear transformations and matrices; bilinear forms; multilinear algebra; determinants; finite dimensional inner product spaces. Prerequisites: Mathematics 104 for 207; and 207 for 208. 3 units per semester. Staff

217, 218. Intermediate Analysis. The real and complex number systems, sequences and series, continuity, differentiation, integration. Prerequisite: Mathematics 104 for 217; and 217 for 218. 3 units per semester. Staff

221, 222. Numerical Analysis. See course description for Computer Science 221, 222. (Also listed as Computer Science 221, 222.) 3 units per semester. Gallie

223. Numerical Analysis III. See course description for Computer Science 223. (Also listed as Computer Science 223.) 3 units. Patrick

***227, 228. Theory of Numbers.** Congruences, arithmetic functions, compound moduli, quadratic reciprocity, Gauss sums, quadratic forms, sums of squares. Prerequisite: calculus. 3 units per semester. Carlitz

***229, 230. Algebraic Numbers.** Ideals, unique factorization, divisors of the discriminant, determination of the class number. Prerequisite: theory of equations. 3 units per semester. Carlitz

***234. Sample Designs.** Methods of constructing and analyzing survey designs; elements of simple random sampling, stratified sampling, multi-stage sampling; methods of estimation; questionnaire construction refusals and not-at-homes. Prerequisite: Mathematics 183. 3 units. Staff

235, 236. Algebra. Elementary categorical algebra; groups with operators, G-sets, structure of groups; commutative algebra; principal ring modules; structure of rings and modules; field theory. Prerequisites: Mathematics 208 or equivalent for 235; and 235 for 236. 3 units per semester. Staff

244. Analysis of Variance. Multiple regression, univariate and multivariate ANOVA, multiple comparisons (Scheffe, Tukey, etc.), factorial designs, analysis of covariance, repeated measurement designs. Prerequisite: Mathematics 183 or equivalent. 3 units. Staff

***245, 246. Combinatorial Analysis.** Generating functions, permutations, distributions, partitions, compositions, trees and networks. Prerequisite: calculus. 3 units per semester. Carlitz

***247, 248. Arithmetic of Polynomials.** Field theory, detailed study of finite fields, special polynomials and functions, valuation theory, the zeta function. Prerequisite: Mathematics 236 or consent of the instructor. 3 units per semester. Carlitz

256. Foundations of Applied Mathematics. Simulation and related notions; relation of science and technology with the evolution of mathematics; modern generalizations of the concepts of language, validity, empirical science, and statistical inference. Areas of application for various specific mathematical topics. Prerequisite: Mathematics 104. 3 units. Murray

260. Design of Experiments. Factorial and fractional factorial designs, confounding, balanced and partially balanced block designs, response surface methodology, method of steepest ascent, comparison of criteria for optimality of design. Prerequisite: Mathematics 136. 3 units. Burdick

***262. Non-Parametric Statistics.** A study of statistical tests in which no assumption about the underlying distribution is made; one sample, two sample, k sample tests for nominal, ordinal and interval scales; non-parametric measures of correlation, efficiency of tests. Prerequisite: Mathematics 244 or consent of the instructor. 3 units. Staff

265, 266. Homological Algebra and its Applications. Categorical algebra; derived categories and homology; sheaves and their cohomology; applications to smooth manifolds and to complex manifolds; preschemes and schemes and their local cohomology. Prerequisites: Mathematics 236 and 271 or consent of instructor. 3 units per semester. Weisfeld

*Offered on demand.

269, 270. Recursive Function Theory. Basic properties, enumeration theorems, hierarchies, recursive function of higher types, generalized recursion theory; applications. Prerequisite: Mathematics 187 or consent of the instructor. 3 units per semester. Shoenfield

271, 272. Introductory Topology. Basic set theory; topological spaces; separation axioms; metric spaces; continuity; connectedness; paracompactness. Prerequisite: calculus. 3 units per semester. Staff

***273, 274. Algebraic Topology.** Homology and cohomology theories; complexes; introduction to homotopy groups; Čech homology theory. Prerequisite: Mathematics 271-272. 3 units per semester. Kraines

***275, 276. Probability.** Foundations of probability. Random variables; distributions; central limit problem; law of large numbers; limit and ergodic theorems. Prerequisites: Mathematics 135 or calculus, and consent of the instructor. 3 units per semester. Stackelberg

284. Least-Squares Analysis of Linear Models. General linear models; geometrical interpretations; multiple regressions; one-way and multi-way analysis of variance; fixed, random, and mixed models; experimental design models; analysis of covariance; introduction to non-linear models. Prerequisite: Mathematics 136. 3 units. Burdick

285. Applied Mathematical Methods I. Vectors, line and surface integrals, tensors, complex variables, differential and integral equations. Prerequisite: Mathematics 104. 3 units. Dressel and Wong

286. Applied Mathematical Methods II. Wave equation. Fourier series, heat equation, telegraphic equations. Legendre polynomials, Bessel functions, Schrödinger's equation. Prerequisite: Mathematics 104. 3 units. Dressel and Wong

***287, 288. Foundations of Mathematics.** Propositional calculus, predicate calculus, axiomatized number theory. Gödel completeness and incompleteness theorems. Recursive functions; hierarchies; constructive ordinals. Set theory; consistency of the axiom of choice. Prerequisite: Mathematics 208 or Philosophy 103 or consent of the instructor. (Also listed as Philosophy 287, 288.) 3 units per semester. Shoenfield

290. Stochastic Processes. Foundations and probabilistic structure of stochastic processes; sample function properties, processes with finite second-order moments, stationary processes; representations. Prerequisite: Mathematics 275. 3 units. Staff

291, 292. Analysis I, II. Theory of analytic functions, measure and integration theory, introduction to functional analysis. Prerequisite: Mathematics 218 or 140 or consent of the instructor. 3 units per semester. Staff

293. Multivariate Statistics. Basic multinormal distribution theory, the multivariate general linear model including the use of Hotelling's T^2 statistic and the Roy union-intersection principle, principal components, canonical analysis, and factor analysis. Prerequisite: Mathematics 284 or consent of the instructor. 3 units. O'Fallon

***295. Mathematical Foundations of Statistical Inference.** Inference-theoretic approach to hypothesis testing, decision-making, and estimation; Neyman-Pearson fundamental lemma; uniformly most powerful test; Fisher's information and sufficiency; invariance and unbiasedness. Prerequisite: Mathematics 275 or consent of the instructor. 3 units. Staff

297, 298. Axiomatic Set Theory. Statement and development of Zermelo-Fraenkel axioms. Consistency and independence problems. New axioms and

*Offered on demand.

their consequences. Prerequisite: consent of the instructor. 3 units per semester. Shoenfield

For Graduates

***303, 304. Advanced Theory of Numbers.** Cubic and quartic reciprocity, partitions and diophantine analysis, sums of squares. Prerequisite: Mathematics 288 or consent of instructor. 3 units per semester. Carlitz

325, 326. Analysis III, IV. Advanced topics in complex and real analysis, measure and integration theory, functional analysis. Prerequisite: Mathematics 292 for 325; and 325 for 326. 3 units per semester. Scoville

***327, 328. Partial Differential Equations.** Boundary and initial value problems, regularity and existence theorems by methods of a priori estimates and functional analysis. Representations of solutions, spectral theory, and potential theory. Prerequisite: Mathematics 291-292 or consent of the instructor. 3 units per semester. Staff

***329, 330. Theory of Distributions.** Test functions, distributions, topological vector spaces, applications to the operational calculus, partial differential equations, and mathematical physics. 3 units per semester. Staff

***331, 332. Advanced Topics in Complex Variables.** Entire and meromorphic functions; harmonic functions and potential theory; Riemann surfaces; several complex variables. 3 units per semester. Staff

***333, 334. Analytic Theory of Numbers.** Distribution of primes, primes in an arithmetic progression, Waring and Goldbach problems, applications of elliptic functions. Prerequisite: Mathematics 291-292. 3 units per semester. Carlitz

***335, 336. Topics in Algebra.** Advanced topics in algebra to be selected from areas of current research. Prerequisite: Mathematics 236 or consent of the instructor. 3 units per semester. Smith

***343, 344. Differential Equations.** Manifolds, sheaves, differential operators and their prolongations, Spencer sequences, δ -cohomology, existence theorems for analytic partial differential equations, the δ -estimate, D-Neumann problem. Prerequisites: Mathematics 236, 272, and 292, or consent of the instructor. 3 units per semester. Weisfeld

***353, 354. Topics in Analysis.** Advanced topics in real and complex analysis to be selected from areas of current research. Prerequisite: Mathematics 325, which may be taken concurrently. 3 units per semester. MacKichan

361, 362. Hilbert Space. Spectral theory for Hermitian and unitary transformations; maximal symmetric transformations; canonical resolution of closed transformations; singular integral equations; the Weyl circle; indices for differential operators; deficiency characteristics of closed transformations; topologies for bounded transformations; von Neumann algebras; resolution theory; Abelian and factor rings. Prerequisites: Mathematics 236 and 292, or consent of instructor. 3 units per semester. Murray

***371, 372. Dimension Theory.** Theory of covers in normal spaces; inductive and covering dimension of metric spaces and of normal spaces; dimension of Euclidean spaces, mapping in spheres and applications; metric dimension and other metric-dependent functions. Prerequisites: Mathematics 271-272. 3 units per semester. Hodel

***377, 378. Topics in Topology.** Advanced topics in topology to be selected from areas of current research. 3 units per semester. Hodel

*Offered on demand.

***383, 384. Lie Groups and Algebras.** Differential manifolds; Lie groups; one-parameter subgroups; Lie algebras; differential forms; classification and representations of compact Lie groups and semisimple Lie algebras; solvable and nilpotent algebras; Ado's theorem. Prerequisites: Mathematics 236, 271, and either Mathematics 218 or 291. 3 units per semester. Shoenfield

***392. Nuclear Spaces.** The theory of nuclear locally convex spaces, as developed by Grothendieck and Pietsch; applications to spaces of distributions. Prerequisite: Mathematics 292. 3 units. Moore

***393. Topological Groups.** Elementary theory; Haar measure; compact groups; locally compact Abelian groups; duality theory. Prerequisites: Mathematics 236 and 272, or consent of instructor. 3 units. Warner

***394. Topological Rings.** Compact, locally compact, and linearly compact rings. Prerequisite: Mathematics 393 or consent of instructor. 3 units. Warner

***395, 396. Topological Algebra.** Normed and locally convex spaces. Banach algebras. Prerequisites: Mathematics 236 and 292, or consent of the instructor. 3 units per semester. Moore

***397, 398. Seminar in Algebra and Number Theory.** Prerequisite: consent of the instructor. 3 units per semester. Carlitz

Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. For a description of the program see p. 22; for a description of individual courses see listings under the specified department.

DEPARTMENT OF ART

- 233. Early Medieval Architecture.** Sunderland
- 234. Romanesque Sculpture.** Sunderland
- 237. French Renaissance Art.** Jenkins
- 238. Sienese Painting.** Jenkins
- 248. Florentine Painting during the Renaissance.** Covi
- 251-252. Research.** Heckscher
- 253. Studies in Italian Renaissance Sculpture.** Covi
- 255, 256. Iconological Problems.** Langedijk

DEPARTMENT OF CLASSICAL STUDIES

Latin

- 221. Medieval Latin I.** Newton
- 222. Medieval Latin II.** Newton
- 225. Palaeography.** Newton
- 305. Latin Seminar V.** Prerequisite: consent of instructor. Newton
- 306. Latin Seminar VI.** Prerequisite: consent of instructor. Newton
- 312. Proseminar in Latin Palaeography.** Newton

Classical Studies

- 327. Seminar in Byzantine History.** Rigsby

*Offered on demand.

DEPARTMENT OF ENGLISH

207, 208. History of the English Language. Nygard and Reiss
210. Old English Literary Tradition. Nygard and Reiss
212. Middle English Literary Tradition. Nygard and Reiss
215, 216. Chaucer. Nygard and Reiss
221. English Prose of the Sixteenth Century. Lievsay
222. English Nondramatic Poetry of the Sixteenth Century. DeNeef and Lievsay
223. Spenser. DeNeef and Lievsay
224. Shakespeare. Williams
225, 226. Tudor and Stuart Drama, 1500-1642. Randall
229. English Literature of the Seventeenth Century. Lievsay, Randall, and Williams
232. Milton. Lievsay
310. Beowulf. Nygard
312. Studies in Middle English Literature. Nygard and Reiss
315. Studies in Chaucer. Nygard and Reiss
318. Medieval Romances. Reiss
320. Studies in Renaissance English Prose. Lievsay
324. Studies in Shakespeare. Williams
325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries. Randall
329. Studies in the Metaphysical Poets. Lievsay and Williams
383. Textual Criticism. Williams

DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

205, 206. Middle High German. Stern
215. Seventeenth-Century Literature. Borchardt
216. History of the German Language. Stern
217. Renaissance and Reformation Literature. Borchardt

DEPARTMENT OF HISTORY

221-222. Problems in the History of Late Medieval and Early Modern Europe. Witt
237-238. Europe in the Middle Ages, 395-1500. Young
267-268. From Medieval to Early Modern England. Ferguson
305-306. Seminar in British History. Ferguson
337-338. Seminar in Medieval History. Young
351.10-352.10. Medieval Europe. Young
351.15-352.15. The English Renaissance. Ferguson

DEPARTMENT OF PHILOSOPHY

218. Medieval Philosophy. Mahoney

DEPARTMENT OF RELIGION

- 236. Luther and the Reformation in Germany.** Steinmetz
- 241. Problems in Reformation Theology.** Steinmetz
- 251. The Counter-Reformation and the Development of Catholic Dogma.**

Raitt

- 334. Church Reformers and Christian Unity.** Steinmetz
- 336. Christian Mysticism in the Middle Ages.** Raitt
- 338. Calvin and the Reformation in Switzerland.** Steinmetz
- 339. The Radical Reformation.** Steinmetz
- 344. Zwingli and the Origins of Reformed Theology.** Steinmetz

DEPARTMENT OF ROMANCE LANGUAGES

French

- 213, 214. French Literature of the Seventeenth Century.** Auld
- 219. Old French Literature.** Vincent
- 224. History of the French Language.** Hull
- 225. French Prose of the Sixteenth Century.** Tetel
- 226. French Poetry of the Sixteenth Century.** Tetel
- 311, 312. French Seminar (Medieval and Renaissance Topics).** Tetel and Vincent

Italian

- 284. Dante.** Fowlie
- 288. The Renaissance.** Tetel

Spanish

- 251. The Origins of the Spanish Novel.** Wardropper
- 252. Spanish Lyric Poetry Before 1700.** Wardropper
- 253. The Origins of the Spanish Theater.** Wardropper
- 257. Old Spanish.** Davis
- 258. Old Spanish Literature.** Davis and Garci-Gomez
- 265. Golden Age Literature: Cervantes.** Predmore and Wardropper
- 266. Golden Age Literature: The Drama.** Wardropper
- 321, 322. Hispanic Seminar (Medieval and Renaissance Topics).** Garci-Gómez, Predmore, and Wardropper

Microbiology and Immunology

Professor Joklik, Chairman (Research Park IV); Professor Willett, Director of Graduate Studies (111 Research Park IV); Professors Amos, Beard, Burns, Conant, Day, Metzgar, and Osterhout; Associate Professors C. Buckley, III, R. Buckley, Rosse, Seigler, Ward, Wheat, and Zweerink; Assistant Professors Bolognesi, Dawson, Lauf, Nichols, Scott, Smith, and Vanaman

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

215. Bacteriophage: Structure and Function. Classical experiments of Luria, Hershey, and Delbrück. Timing of events during infection. Morphogenesis of component substructures and their subsequent assembly into mature virions. Analysis of electron micrographs. Interactions of bacteriophage with host-cell walls and membranes. These areas will be covered in the context of coliphages. (Also listed under the University Program in Genetics.) Fall. 2 units. Nichols

219. Molecular and Cellular Basis of Development. See course description for Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Pathology 219, and Physiology 230.) 3 units. Counce and Staff

219S. Seminar. Optional seminar offered in conjunction with Microbiology 219.

221. Medical Microbiology. An intensive study of the common bacteria, viruses, fungi, and parasites which cause disease in man. The didactic portion of the course focuses on the nature and biological properties of microorganisms causing disease, the manner of their multiplication, and their interaction with the entire host as well as specific organs and cells. 4 units. Joklik and Staff

233. Microbiology. A course designed to provide students with a basic understanding of the microbial world. Special emphasis will be given to structure, composition, growth, and metabolism of bacterial cells. 3 units. Willett, Burns, Joklik, and Amos

252. General Animal Virology and Viral Oncology. The first half of the course will be devoted to a discussion of the structure and replication of mammalian viruses with special emphasis on the molecular and functional aspects. A second part of the course will deal specifically with tumor viruses, which will be discussed in terms of the virus-cell interaction and the response to the host. The relationship of virus infection to neoplasia will be emphasized. 4 units. Joklik, Smith, Zweerink, and Nichols

282. Molecular Microbiology. A study of the structure, growth, and replication of bacteria with a detailed analysis of the synthesis and regulation of the structural, informational, and catalytic macromolecules. Major topics covered include: structure, function, and synthesis of bacterial integuments, DNA, RNA, and protein; genetic and metabolic regulatory mechanisms; primitive differentiation in prokaryotes. Prerequisite: general biochemistry. 4 units. Burns, Nichols, Vanaman, Wheat, and Willett

291. Immunology I. Structure and function of immunoglobulins. Characteristics of synthetic and natural antigens. Cellular aspects and kinetics of antibody formation. Forms of immunologic responsiveness. Elicitation and control of immune response. Phylogeny and ontogeny of immunity. Specificity and cross-reactivity. Methods of immunologic analysis. Tolerance, enhancement, autoimmunity, and allergy. 4 units. Scott and Staff

292. Immunology II. Continuation of Immunology I. 4 units. Scott and Staff

For Graduates

311. Immunochemistry. The primary and conformational structures of the immunoglobulins—chains, regions, sizes, allotypes, evolution. The antibody binding site—location, specificity, subgroups, idiotypes, antigen ac-

commodation. The reaction of antibodies—affinity and the law of mass action, homogeneous binding, kinetics, virus model, precipitation reactions, active centers of multivalent antigens, conformational determinants. Affinity, the immune responses, and clonal selection. 3 units. Day

313. Immunohematology. A lecture course covering historical and current concepts of blood cell antigens and antibody. Emphasis will be placed on the genetics, serology, chemistry, and anthropological aspects of human red cell isoantigens and antibodies. White cell and platelet antigens, the hematological consequences of immunological reactions involving the cellular elements of the blood, and comparative blood group antigens in other species will also be considered. 2 units. Rosse

323. Readings in Bacteriology and Immunology. A course of readings and syntheses in restricted areas of bacteriology and immunology under the direction of individual staff members. 2 units.

325. Medical Mycology. This course is intended to familiarize the graduate student majoring in mycology with the fungi causing disease in man and animal. The course includes practical laboratory work with materials from patients in Duke Hospital and those sent to the Duke Fungus Registry from outside sources. Prerequisites: a master's degree in botany with major in mycology and Microbiology 221. Maximum registration: four students. 4 units. Conant

330. Medical Immunology. Basic study of immune responses to antigenic substances. Special topics: congenital and acquired immunological deficiencies; humoral and cellular hypersensitivity; immunology and infectious diseases; immunohematology; autoimmune disease; the immunogenetics of transplantation; tumor specific immunity. 6 units. Amos and Staff

331.1-331.8. Microbiology Seminar. Current topics in microbiology with seminars presented by students, faculty, and outside speakers. Required course for all first-year students in microbiology and immunology, and for all advanced students specializing in microbiology. 1 unit per semester. Staff

332.1-332.8. Immunology Seminar. Current topics in immunology with seminars presented by students, faculty, and outside speakers. Required course for all first-year students in microbiology and immunology, and for all advanced students specializing in immunology. 1 unit per semester. Staff

336. Immunogenetics. Antigens of tissues and organs, distribution, extraction and chemistry. Phylogeny of iso-antigenic systems of man and animals. Tests for histocompatibility including lymphocyte interactions and reactivity. Change in antigenicity and immune responsiveness in carcinogenesis. Immunologic factors in pregnancy and in homotransplantation of organs. (Also listed under the University Program in Genetics.) 2 units. Amos and Ward

420. Cellular Immunophysiology. See course description for Physiology 420. (Also listed as Physiology 420.) 2 units. Lauf and Staff

Pathology

Professor Kinney, Chairman (301B Medical School); Professor Sommer, Director of Graduate Studies (301 Medical School); Professors Fetter, Hackel, Johnston, Klintworth, Vogel, Pratt, and Wittels; Associate Professors Elchlepp, Bradford, and Ratliff; Assistant Professors Adams, Bigner, Bossen, Daniels, Dorsey, Graham, Hawkins, Jauregui, Shelburne, Spooner, Tisher, and Wilson

The Department of Pathology offers graduate work leading to the M.S. and Ph.D. degrees with areas of specialization such as subcellular and mo-

lecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of modern research techniques. Students will be required to take such courses as are necessary to obtain this foundation, and as are best adapted to areas of specialty and research. Further information including brochures giving details of departmental facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

219. Molecular and Cellular Basis of Development. For a description of the course see Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Microbiology 219, Pathology 219, and Physiology 230.) 3 units. Counce, McCarty, and Staff

219S. Seminar. Optional seminar offered in conjunction with Pathology 219.

250. General Pathology. The fundamentals of pathology are presented to the student. Lectures developing broad concepts of disease processes are given by the members of the senior staff. The emphasis is placed on etiology and pathogenesis of disease. Lecture. Prerequisites: histology and permission of instructor. 4 units. Kinney and Staff

251. Laboratory Course in General Pathology. Laboratory session to complement 250. Gross and microscopic material is correlated with, and related to, disease processes. Pathology 250 may be taken concurrently. Prerequisites: histology and permission of instructor. 4 units. Kinney and Staff

325. Cardiovascular Pathology. Cardiovascular disease processes will be studied, reviewing anatomic, embryologic, and physiologic features, and utilizing case material and gross and microscopic specimens. Consideration will be given to principles of electrocardiography. Fall only. 3 units. Hackel and Ratliff

352. Basic Problems in Chemical Pathology. This is an advanced seminar tutorial course in which the biochemical and physiological expressions of morphologic abnormalities will be explored. Specific organ systems will be used as a model for instruction and discussion. Experimental approaches toward solutions of problems will be discussed. Prerequisite: permission of instructor. 2 units. Wittels

353. Advanced Neuropathology. This course deals with current problems and research methods related to diseases which affect the nervous system. Prerequisite: permission of instructor. Fall only. 2 units. Vogel

355, 356. Graduate Seminar in Pathology. Discussions outlining the scope of modern pathology. This will include reports of original researchers by members of staff and visitors. Time to be arranged. 1 unit each semester. Sommer and Staff

357. Research in Pathology. Independent research projects in various fields of pathology. Time and credit to be arranged. Kinney and Staff

358. Cellular and Subcellular Pathology. This course is designed for students wishing to broaden their knowledge of cellular structure and cellular pathology. The course consists of lectures and seminars discussing the alterations in cellular structure and associated functions that accompany cell injury. Prerequisite: permission of instructor. Sommer

360. Histochemistry. Theory and application of histochemical techniques for investigating the presence of proteins, lipids, carbohydrates, and enzymes at the light and/or electron microscopic level. A quantitative identification of nucleoproteins by cytophotometric and autoradiographic techniques will be given special consideration. Students will be encouraged to

develop a small project of their choice. Fall and spring. 3 units. Jauregui and Staff

361, 362. Autopsy Pathology. A detailed consideration of the morphologic, physiologic, and biochemical manifestations of disease. Emphasis is on individual work in the laboratory with tutorial supervision. Gross dissection, histologic examination, processing, and analyzing or morphologic, microbiologic, and biochemical data, and interpretation of results. Prerequisites: Pathology 350 and permission of instructor. 3 units per semester. Kinney and Staff

364. Systemic Pathology. Systematic presentation of the characteristics of disease processes as they affect specific organ systems in mammals. 6 units. Hackel and Staff

367, 368. Special Topics in Pathology. Special problems in pathology will be studied with a member of the senior staff; the subject matter will be individually arranged. Time to be arranged. 4 units. Kinney and Staff

369. Ophthalmic Pathology. This course will consist of lectures seminars, and laboratory sessions. The normal anatomy and embryology of the eye will be reviewed as a basis for the study of the various ocular disease processes. The more common diseases of the eye will be considered in detail. Problems in ophthalmic pathology will be discussed together with methods of solving them. Fall only. 3 units. Klintworth

370. Developmental Pathology and Teratology. A systematic study of disease processes involving the prenatal, natal, and postnatal period. Emphasis will be placed on developmental anatomy and teratogenesis. The format includes seminars and clinicopathologic correlations derived from gross and microscopic material. Prerequisites: Pathology 350, anatomy, and histology. Fall only. 3 units. Bradford and Wilson

373. Cytopathology. This course is designed to present the principles and techniques by which basic cytology is applied to the diagnostic interpretation of disease. Classroom and laboratory work will include diseases involving the female genital tract, respiratory tract, urinary tract, effusions, gastrointestinal tract, and central nervous system. Neoplastic disease will be emphasized. Practical application of the acquired knowledge will be made in examining current material. Prerequisites: Pathology 350, 351, or permission of instructor. Fall. 3 units. Johnston and Staff

374. Pulmonary Pathology and Postmortem Pathophysiology. Emphasis will be on pulmonary pathology and pathophysiology of infectious, metabolic, environmental, and neoplastic diseases, and certain diseases of unknown etiology (e.g., sarcoid, alveolar proteinosis, etc.). Ventilatory experiments will be done on excised human lungs. Fall. 3 units. Pratt

375. Fundamentals of Electron Microscopy. The course will consist of one lecture and one seminar per week, covering the theoretical basis of practical electron microscopy. Areas to be discussed include the nature of light and electrons, light and electron optics, image recording and processing by photographic and other methods, specimen preparation, functional anatomy of the electron microscope, and several special techniques. Student presentations and selection of special topics will be encouraged. The approach will be non-mathematical, but college physics is strongly recommended. Fall and spring. 2 units. Sommer and Staff

377. Pathology of the Kidney. The course includes a comprehensive study of pathological, immunological, and clinical features of the glomerulo-

nephritides, the nephrotic syndrome, and pyelonephritis, as well as of metabolic, congenital, and neoplastic renal disorders. Lectures will be supplemented with gross and microscopic specimens, demonstrations, and special library studies. Fall. 3 units. Tisher

378. Immunopathology. A study of human diseases in which the immune system plays an important role. A series of lectures, seminars, and studies of human case materials. Fall. 4 units. Daniels, Bigner, Adams, and Bossen

379. Pathology of Virus Infections. The pathological effects of viruses will be discussed. A series of lectures and student-conducted seminars concerning the structural, biochemical, and functional alterations associated with virus-cell interactions. Spring. 4 units. Daniels and Bigner

Philosophy

Professor Welsh, Chairman (201K West Duke Building); Associate Professor Mahoney, Director of Graduate Studies (201J West Duke Building); Professors Dray, Negley, and Peach; Associate Professors Roberts and Sanford; Assistant Professors Aquila, Benditt, and Ross

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophical analysis, ethics, aesthetics, political philosophy, and philosophy of law.

Individual programs of study are developed for each student. The following requirements, however, are fundamental: (1) In February of their first year new graduate students are required to take two or three qualifying examinations, diagnostic in purpose. One examination is in the history of philosophy, ancient and modern; a second examines his ability to deal critically and systematically with some basic philosophical topic; a third examination, in logic, is required of anyone who has not taken a graduate-level logic course during his first term. (2) The preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor or related field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for the A.M. or the Ph.D. degree and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School for the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. No student may take his preliminary examination until he has demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

For Seniors and Graduates

202. Aesthetics: The Philosophy of Art. A study of some fundamental issues in aesthetics with particular reference to the fields of literature, music,

and painting. Problems discussed include the role of standards in criticism, aesthetic judgment, interpretation, and evaluation in literature, meaning in the arts, art and truth, the arts and morality. 3 units. Welsh

203. Contemporary Ethical Theories. Study of the nature and justification of basic ethical concepts and principles in the light of the chief ethical theories of twentieth century British and American philosophers. 3 units. Benditt

204. Philosophy of Law. Natural law theory and positivism; the idea of obligation (legal, political, social, moral); and the relation of law and morality. 3 units. Benditt

205. Philosophy of History. The nature of historical knowledge and inquiry and theories of the historical process. 3 units. Dray

206. Topics in Ethical Theory. 3 units. Benditt

208. Political Values. Analysis of the systematic justification of political principles and the status of political values in the administration of law. 3 units. Negley

211. Plato. A critical study of selected dialogues with special emphasis on problems in epistemology and metaphysics. 3 units. Mahoney

217. Aristotle. A study of passages from the Organon, Physics, De Anima, and Metaphysics. 3 units. Mahoney

218. Medieval Philosophy. A critical examination of selected problems in medieval philosophy. 3 units. Mahoney

225. British Empiricism. A critical study of the writings of Locke, Berkeley, or Hume, with special emphasis on problems in the theory of knowledge. 3 units. Peach

227. Continental Rationalism. A critical study of the writings of Descartes, Spinoza, or Leibniz, with special emphasis on problems in the theory of knowledge and metaphysics. 3 units. Peach and Roberts

228. Recent and Contemporary Philosophy. A critical study of some contemporary movements in philosophy with special emphasis on the work of Moore, Russell, Wittgenstein, Wisdom, and Ryle. 3 units. Welsh

230. The Meaning of Religious Language. See course description for Religion 230. (Also listed as Religion 230.) 3 units. Poteat

231. Kant's Critique of Pure Reason. 3 units. Aquila

232. Recent and Continental Philosophy. Selected topics. 3 units. Aquila

233. Methodology of the Empirical Sciences. Recent philosophical discussion of the concept of a scientific explanation, the nature of laws, theory and observation, probability and induction, and other topics. Prerequisite: consent of instructor for students from other departments. 3 units. Ross

234. Problems in the Philosophy of Science. Selected problems in the physical and nonphysical sciences such as space and time, measurement, and determinism in science. Prerequisite: consent of instructor for graduate students from other departments. 3 units. Ross

241. Symbolic Logic. Detailed analysis of deduction and of deductive systems. 3 units.

251. Epistemology. Selected topics in the theory of knowledge, e.g., conditions of knowledge, scepticism and certainty, perception, memory, knowledge of other minds, and knowledge of necessary truths. 3 units. Sanford

252. Metaphysics. Selected topics in metaphysics, e.g., substance, qualities and universals, identity, space, time, causation, and determinism. 3 units. Sanford

253. Philosophy of Mind. An analysis of mental concepts such as thought and belief; and such issues as mind-body relations, thought and action; the nature of persons and personal identity. 3 units. Aquila

254. Philosophy of Religion. Topics such as proofs of the existence of God, meaningfulness of religious language, the problem of evil, and immortality and resurrection. 3 units. Roberts

255. Philosophy of Action. Problems in the individuation, characterization, and explanation of human actions; analysis of such concepts as choosing, deciding, intending, doing, making, and letting. 3 units. Dray

260. Wittgenstein. An examination of the Tractatus or the Investigations. 3 units. Welsh

287, 288. Foundations of Mathematics. See description for Mathematics 287, 288. (Also listed as Mathematics 287, 288.) 3 units per semester. Henson

291, 292. Seminar in Special Fields of Philosophy. 3 units. Graduate Staff

For Graduates

331, 332. Seminar in Special Fields of Philosophy. 3 units. Graduate Staff

Physical Therapy

Assistant Professor Mathews, Acting Chairman and Director of Graduate Studies (045 Hospital); Associate Professor Branch; Assistant Professor Villanueva

The Department of Physical Therapy offers a basic professional program leading to the M.S. degree. To be eligible for admission to the program, applicants must have obtained a baccalaureate degree and have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and mathematics. In the first year of the curriculum students are required to take Anatomy 300 and Physiology 200. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3247, Duke University Medical Center.

201, 202. Seminar in Physical Therapy. Historical background and trends in the profession; orientation to physical therapy departmental organization and administration; professional and community relationships; professional ethics; methods of communication; and literature review. Units by arrangement. Mathews and Staff

217. Physical Therapy Dynamics I. Orientation to patient care; principles of biomechanics and applied anatomy; introduction to microscopic anatomy. 3 to 4 units. Branch, Mathews, Villanueva, and Staff

218. Physical Therapy Dynamics II. Regional approach to the process of human movement analysis, including kinesiological analysis of normal and pathological patterns of gait; introduction to therapeutic exercise, with emphasis on rationale and methods of treatment; principles and practice of physical therapy procedures, with emphasis on biophysical and physiological considerations for utilization of selected therapeutic agents (mechanical, thermal, chemical, and electrical). 5 units. Branch, Villanueva, and Staff

220. Physical Therapy Dynamics III. The role of the central nervous system in the inhibition or facilitation of motor behavior as related to the management of patients with central nervous system disorders. Emphasis on the application of current neurophysiological concepts to the evaluation of patients with central nervous system deficits and to the planning and administration of treatment programs. 2 to 4 units. Villanueva and Staff

230. Physical Evaluation and Instrumentation. Principles and techniques of objective assessment and analysis of functional status, including manual muscle tests, dynamometry, goniometry, electrical diagnostic testing, posture analysis, body measurements, evaluation of respiratory and sensory function, disability evaluation, and orientation to electromyography and nerve conduction studies. 3 units. Staff

234. Introductory Pathology. Fundamentals of pathology with emphasis on broad concepts of disease processes; systems of the body are studied from the point of view of histological and functional change. 3 units. Branch and Special Lecturers

236. Medical Sciences. Lectures by clinicians with patient demonstrations and correlation of treatment methods; medical and surgical, neurological, orthopaedic, and emotional conditions affecting human dysfunction; emphasis on psychodynamic principles of patient-therapist relationships. 4 units. Staff and Special Lecturers

238. Introduction to Health Service Systems. Political, economic, and sociocultural aspects of the organization of health care systems; structural components and interrelationships; criteria for assessing and analyzing health care systems. 2 to 3 units. Mathews

242. Directed Clinical Experience in Physical Therapy I. Students are assigned to hospitals, rehabilitation centers, schools for crippled children, extended-care facilities, and public health units for short-term supervised learning experiences. 1 to 2 units. Staff

243. Directed Clinical Experience in Physical Therapy II. Students are assigned to full-time learning experiences under direction. 2 to 4 units. Staff

301. Introduction to Scientific Inquiry. Theory and use of analytical methods of problem-solving; elements of scientific writing; preparation of a research protocol and a major paper. 3 units. Mathews

315. Curriculum Development. Introduction to learning theory; development of objectives, organization, course content, and evaluation in physical therapy education. 2 to 3 units. Staff

316. Directed Teaching in Physical Therapy. 1 to 3 units. Staff

320. Sensorimotor Mechanisms Related to Rehabilitation. Development of normal motor behavior, and structural and functional organization of the nervous system related to methods of facilitating functional capacities for performing the activities of daily living. 2 to 3 units. Villanueva and Staff

322. Case Conferences in Rehabilitation. Observation and demonstration of care of patients with extensive disability; emphasis on integration of health services for comprehensive care via the case conference approach. 1 to 2 units. Staff

332. Administration of Physical Therapy Services. Principles of administration, leadership styles, and management roles; concepts of systems theory and analysis; planning organizing, delivering, and evaluating physical therapy systems and subsystems. 3 units. Mathews

341-342. Advanced Seminar—Selected Problems. 2 to 3 units. Staff

350. Research. Units by arrangement. Staff

Physics

Professor Newson, Chairman (119 Physics Building); Associate Professor Evans, Director of Graduate Studies (111 Physics Building); Professors Biedenharn, Bilpuch, Fairbank, Gordy, Greuling, Lewis, Meyer, Robinson, and Walker; Adjunct Professors Robl and Way; Associate Professors Cusson, Fortney, Han, Roberson, and Walter; Assistant Professors Delucia, Goshaw, Loos, Riedel, and Sykes

The Department of Physics offers graduate work for students wishing to earn the A.M. or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields, in which research is being done by students, faculty, and staff.

With the help of faculty advisers, each student selects a course program to fit his needs, including work in a related field, usually mathematics or chemistry. Students are encouraged to begin research work early in their career.

The department does not ordinarily accept students for work toward the A.M. degree only, and students making good progress are advised to work directly for the Ph.D. degree. The option of taking the A.M. without thesis is available with the approval of a departmental committee.

A reading knowledge of one language, usually chosen from French, German, or Russian, is required for the Ph.D. degree.

For Seniors and Graduates

211, 212. Advanced Modern Physics. Quantum theory with applications to the study of atoms, molecules, solids, and nuclei. Prerequisites: Physics 161, 181, or equivalents; Mathematics 285-286 or equivalent (may be taken concurrently). 3 units per semester. Robinson

215. Introduction to Quantum Mechanics. Wave mechanics and elementary applications; the hydrogen-like atoms; electron spin and angular momentum; operators and eigenvalues; stationary state perturbation theory; identical particles. Prerequisites: courses in modern physics and intermediate mechanics; Mathematics 285-286 may be taken concurrently. 3 units. Evans

217, 218. Advanced Physics Laboratory and Seminar. Measurements involving the fields of mechanics, electricity, magnetism, heat, sound, optics, and modern physics. 3 units per semester. Meyer

220. Electronics. Basic elements of modern electronics including a.c. circuits, transfer functions, solid state service, transistor circuits, operational amplifier applications, digital circuits, and computer interfaces. 3 units. Fortney

223. Electricity and Magnetism. Electrostatic fields and potentials, boundary value problems, magnetic fields and potentials, magnetic induction, energy in electromagnetic fields. Maxwell's equations, introduction to electromagnetic radiation. 3 units. Loos

282. Mechanics of Continuous Media. Small vibrations, rigid body motion, hydrodynamics, elasticity. Prerequisites: Physics 41-42 or 51-52 and differential and integral calculus. 3 units. Walker

For Graduates

302. Advanced Mechanics. The fundamental principles of Newtonian

mechanics; general dynamics of systems of particles and rigid bodies; the methods of Lagrange and Hamilton; generalized mechanics. 3 units. Cusson

303. Statistical Mechanics. Fundamental laws of thermodynamics and statistical mechanics with applications to physics and chemistry. Classical and quantum ideal gases; approximate methods for real gases and liquids. Prerequisite: Physics 215. 3 units. Sykes

***304. Advanced Topics in Statistical Mechanics.** This course will vary from year to year. Possible topics include Fermi liquids, systems of bosons, many-body theory, non-equilibrium statistical mechanics. Prerequisites: Physics 303 and 316. 3 units. Sykes

305. Introduction to Nuclear Physics. Phenomenological aspects of nuclear physics; interaction of gamma radiation and charged particles with matter; nuclear detectors; particle accelerators; radioactivity; basic properties of nuclei; nuclear systematics; nuclear reactions, particle scattering; nuclear models of the deuteron; nuclear forces; parity. 3 units. Roberson

***306. Low Temperature Physics.** The properties of matter near the absolute zero of temperature; superconductivity, liquid helium, adiabatic demagnetization. Prerequisite: Physics 303. 3 units. Fairbank

308. Introduction to High Energy Physics. High energy processes; electromagnetic, weak, and strong interactions. 3 units. Walker

309. Solid State Physics I. Properties of matter in the condensed state; crystal lattices, electrons in metals and semiconductors, band theory, non-metallic solids, lattice dynamics, and phonons. Prerequisites: Physics 215 and 303. 3 units. Riedel

***310. Solid State Physics II.** Elementary excitations and their interactions in the condensed state of matter; scattering theory and correlation functions; magnetic interactions in solids, superconductivity; amorphous solids. Prerequisites: Physics 309 and 316. 3 units. Riedel

312. Phase Transitions and Critical Phenomena. Description of phase transitions in diverse physical systems such as fluids, magnets, mixtures, and superfluids. Experimental techniques and results. Application of the classical methods of thermodynamics, correlation functions, and mean field theory to the critical state of matter. Microscopic models of phase transitions. Modern approaches to static and dynamic critical phenomena such as the theories of critical exponents, scaling, series expansions, critical relaxation, and mode-mode coupling. 3 units. Riedel

316. Principles of Quantum Theory. Original and fundamental concepts of quantum theory; wave and matrix mechanics; theory of measurements; exclusion principle and electronic spin. Prerequisite: Physics 302. 3 units. Evans

317. Intermediate Quantum Theory. General operator methods; angular momentum; Dirac electron theory. Second quantization; symmetry principles and conservation theorems. Applications to the theory of solids, of nuclei, and of elementary particles will be stressed. Prerequisite: Physics 316. 3 units. Biedenharn

318. Electromagnetic Field Theory. Electrodynamics; theory of wave optics; radiation of electric and magnetic multipole fields; special relativity; covariant electrodynamics; Lienard-Wiechert potentials; scattering and dispersion; Hamiltonian field equations. Prerequisite: Physics 223. 3 units per semester. Greuling

*Offered on demand.

***330. Nuclear Structure Theory.** Two body nuclear forces used to describe nuclear structure; nuclear shell and collective models; properties of nuclear levels; magnetic and quadrupole moments; transition probabilities; nucleon-nucleon scattering; nuclear reactions. Prerequisites: Physics 305 and 316. 3 units.

***331. Microwave Radiation.** Microwave generators, cavity resonators, transmission lines, radiation propagation, and detection. 3 units. Gordy

***335. Microwave Spectroscopy.** Application of microwaves in the determination of molecular, atomic, and nuclear properties. Stark and Zeeman effects in microwave spectroscopy. Magnetic resonance absorption. 3 units. Gordy

***341. Advanced Topics in Quantum Theory.** Introduction to relativistic quantum field theory; Lorentz and Poincaré groups; quantization of free fields; interacting fields and S-matrix; applications to quantum electrodynamics and dispersion relations. Prerequisite: Physics 317. 3 units. Han

***342. Theory of Elementary Particles.** Theoretical methods used in treating particle interactions, emphasizing phenomenological treatments. Quantum field theory and dispersion theory is developed as needed. Applications in the general areas of pion physics, electromagnetic interactions of hadrons, strange particle interactions, and weak interactions are surveyed. Prerequisite: Physics 316. 3 units. Han

***343. Nuclear Physics.** Elementary theory of the deuteron; low energy neutron-proton scattering; theory of nuclear reactions; penetration of potential barriers; nuclear energy levels. Prerequisite: Physics 215. 3 units. Newson

***344. Advanced Nuclear Physics.** The deuteron, nuclear forces, scattering of elementary particles, beta-radiation. Other aspects of nuclear physics susceptible of theoretical interpretation. 3 units. Biedenharn

***345. High Energy Physics.** Experimental and theoretical aspects of high energy nuclear processes; properties of mesons and hyperons. 3 units.

***346. Topics in Theoretical Physics.** The content of this course will vary from year to year. General methods in quantum mechanics such as group theory and its applications; elementary particle theory; field theory; theory of solids; theoretical nuclear physics; atomic and molecular structure. Prerequisites: Physics 316, 317. 3 units.

351, 352. Seminar. A series of weekly discussions on topics related to the research projects under investigation in the department. 2-4 units. Graduate Staff

397, 398. Low Temperature and Solid State Seminar. Weekly seminar on advanced topics and recent research work in the field of low temperature and solid state physics. 2-4 units. Riedel and Sykes

Physiology and Pharmacology

Professor Tosteson, Chairman (388 Medical Sciences I); Associate Professor McManus, Director of Graduate Studies (354 Medical Sciences I); Professors Bernheim, Blum, Hitchings, Jöbsis, Johnson, Lack, Maxwell, Moore, Narashashi, Nichol, Renkin, Schanberg, and Somjen; Associate Professors Fellows, Kylstra, Lauf, Menzel, Ottolenghi, Padilla, Posner, Salzano, and Wolbarsht; Assistant Professors Anderson, Elford, Greenfield, Gunn, Gutknecht, Kirk, Kootsey, Lebovitz, Lieberman, Mandel, Mendell, Mills, Rosen, Rosenthal, Schomberg, Schooler, Slotkin, and Wachtel

The Department of Physiology and Pharmacology offers graduate work leading to the Ph.D. degree. Before undertaking this program a student should have a strong background in basic sciences including course work in mathematics, biology, physics, and chemistry through physical chemistry. Undergraduates with this background may have majors in any of the following areas: biology, chemistry, physics, or engineering. There is no foreign language requirement. All graduate students are required to take the introductory courses in both physiology and pharmacology. A brochure which describes the program of study, facilities, and the research activities of the staff is available from the Director of Graduate Studies.

For Seniors and Graduates

200. Introduction to the Physiology of Man. Lectures and conferences on organ physiology are given after an introductory presentation of the basic principles of cell physiology. Human and medical aspects are stressed in the clinical conferences and the laboratory experience. The neurophysiology section is given in a three-week period following the end of the semester. Limited to students whose training requires knowledge of human physiology as it pertains to medicine. Three lectures, two conferences (one of which is clinical), and one laboratory per week. Prerequisites: permission of the course leader. Fall. 7 units. Jöbsis and Staff

202. Introduction to Physiology. The lectures are the same as those in Physiology 200, but the conference is separate without the emphasis on human or medical aspects. The neurophysiology unit of Physiology 200 given in a three-week period following the end of the semester is required of all registrants. Designed for graduate students. Three lectures and one conference per week. Prerequisites: permission of course leader. Fall. 5 units. Jöbsis and Staff

203. Advanced Physiology. Material presented demonstrates in greater depth and detail than Physiology 202, the experimental basis and theoretical framework of contemporary physiological thinking. Controversial problems are introduced and recent literature discussed. Designed for graduate students and to be taken with Physiology 202 unless the student has already had an equivalent course approved by the course leader. Two lectures, one conference, and one laboratory per week. Prerequisites: undergraduates—permission of the course leader. Fall. 4 units. Somjen and Staff

208. Respiratory System in Health and Disease. Primary emphasis on the physiology of respiration. Topics include pulmonary mechanics, gas exchange, ventilation-perfusion relationships, central and peripheral regulation of ventilation and respiratory responses to exercise, altitude, and hyperbaric environments. Spring. 2 units. Salzano and Kylstra

210, 211. Individual Study and Research. Directed reading and research in physiology and pharmacology. Prerequisites: senior standing and permission of the Director of Graduate Studies. Fall and spring. 3 to 9 units per semester. Staff

212. Membrane Physiology and Osmoregulation. Physiology of aquatic organisms, with emphasis on cellular transport and electrophysiological processes. Includes lectures and laboratory work on the mechanisms and comparative aspects of ionic and osmotic regulation in plants and animals. (Given at Beaufort.) Prerequisite: permission of instructor. Summer. 6 units. Gutknecht, Wachtel, and Staff

215. Topics in Developmental Physiology and Pharmacology. An analy-

sis of the physiological basis of development at the organ level with special reference to vertebrates. Topics include development of neuronal connections, cardiogenesis, hormonal regulation, and pharmacological interactions in organogenesis. Prerequisite: permission of instructor. Alternate years beginning spring, 1975. 2 units. Lieberman, Mendell, and Padilla

216. Contractile Processes. Cellular basis of activity in cilia and skeletal, cardiac, and smooth muscle; submicroscopic structure and behavior of muscle; special properties of muscle membranes; the problem of electro-mechanical coupling; mechanics, thermodynamics, and biochemistry of muscular contraction; developmental and adaptive changes in function. Prerequisite: permission of instructor. Alternate years beginning fall, 1974. (Listed also as Anatomy 215). 3 units. Anderson, Jöbsis, Johnson, and Reedy

217. Membrane Transport in Physiology and Pharmacology. Chemical composition and ultrastructure of biological membranes, ionic and osmotic equilibria across the membranes of individual cells, passive and active ionic transport, the role of ATPase, carrier-mediated diffusion of non-electrolytes, integration of transport processes to produce molecular movements across organized epithelia (e.g., amphibian skin and bladder and gastrointestinal mucosa). Prerequisite: permission of instructor. Fall. 3 units. Gunn, Gutknecht, Kirk, Lauf, McManus, and Tosteson

230. Molecular and Cellular Basis of Development. See course description for Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Microbiology 219, and Pathology 219). Fall. Padilla, Counce, McCarty, and Staff



230S. Optional seminar offered in conjunction with Physiology 230.

250. Pharmacology: Mode of Action of Drugs. The pharmacological action of drugs in terms of biochemical and physiological processes. Three lectures and one conference per week. Prerequisite: Physiology 200 or equivalent. Spring. 4 units. Menzel and Staff

252. Cellular and Chemical Pharmacology. Chemical aspects of cell-drug interaction and structure-activity relationships. Stereochemistry. Cholinergic and adrenergic mechanisms. Drug design. Alternate years beginning fall, 1974. 3 units. Ottolenghi and Staff

254. Mammalian Toxicology. Principles of toxicology as related to man. Emphasis on the molecular basis for toxicity of chemical and physical agents. Subjects include the limitations and assumptions of extrapolation to man from animal toxicity, safety of drugs and food additives, toxicity of pesticides and their hazard to man, and the role of scientists in societal decisions on the use of man-made chemical and physical agents. Prerequisite: permission of instructor. Fall. 3 units. Menzel and Staff

256. Human Nutrition. Nutrition principles with emphasis on physiology and pharmacology. Topics include the chemical basis for nutrient requirements, application to practical diets, parenteral nutrition, influence of dietary intake on disease (cardiovascular disease, diabetes, and inborn errors of metabolism), optimal dietary intake, impact of food technology on human nutrition, growth, maturation, and lactation and their requirements and recent advances in micronutrient requirements. Prerequisite: permission of instructor. Fall. 2 units. Menzel

280. Student Seminar in Physiology and Pharmacology. Preparation and presentation of seminars to students and faculty on topics of broad interest to physiology and pharmacology. Required of all physiology and pharmacology graduate students. Fall and spring. 2 units. Gunn

For Graduates

321. Gastrointestinal and Renal Physiology. Mechanisms of intestinal secretion, digestion, absorption, and motility, and their control at a cellular level. Basic renal mechanisms involved in the elaboration of urine including concentrating and diluting mechanisms, hemodynamics, and regulation of acid-base balance. Spring. 3 units. Gunn and Tosteson

325. Microcirculation: Rheology and Transport. Lectures and conferences on microvascular flow and its control, mechanics of blood plasma, blood cells and tissues, blood-tissue exchange of materials. Prerequisites: animal or human physiology, mathematics through calculus, or consent of instructor. (Listed also as Biomedical Engineering 325.) Spring. 2 units. Renkin and Evans

330. Pharmacological Basis of Clinical Medicine. This course consists of a detailed analysis of the mechanism of action and rationale for use of pharmacologic agents in disease states. Fall. 4 units. Schanberg and Staff

331. Laboratory Methods in Pharmacology. Tutorial laboratory training will be given in various fields of pharmacology including neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and biophysical pharmacology. Certain special laboratory sessions will be conducted at the Burroughs Wellcome Research Laboratories, Research Triangle Park. Prerequisite: permission of instructor. Fall and spring. 3 to 6 units. Narahashi, Maxwell, and Staff

334. Pharmacodynamics. Introduction to the fundamentals of physical

processes in biological systems as they pertain to drug action. Specific topics include pharmacokinetics, drug absorption, distribution, metabolism and excretion, receptor theory, Hansch correlation of molecular structure with biological activity, and molecular orbital theory. Fall. 2 units. Rosen and Slotkin

362. Current Topics in Cardiac Muscle Physiology. Selected topics in the physiology and pharmacology of cardiac muscle, including general and comparative morphology and ultrastructure, cardiac electrophysiology and mechanics, and excitation-contraction coupling. Spring. 2 units. Johnson and Staff

372. Research in Physiology and Pharmacology. Laboratory investigation in various areas of physiology and pharmacology. Fall and spring. Credits to be arranged. Staff

383. Physiological Instrumentation. Electronic methods of measurement of physiological variables. The operational amplifier is used as the active building block in appropriate feedback circuits containing only passive elements to make a wide range of linear instruments including analog computers. Digital logic and computing elements are also developed. Alternate years beginning spring, 1975. 3 units. Moore and Staff

393. Integrative and Clinical Neurophysiology and Neuropharmacology. Aspects of the physiology and pharmacology of the central nervous system in health and in disease: sensory coding; reflex functions; motor control; effects of drugs on the CNS; physiological aspects of memory. Spring. 3 or 4 units. (Extra unit available upon permission of instructor.) Somjen and Staff

395. Biochemical Pharmacology. Emphasis on mechanism of action of drugs in the areas of (1) metabolism and toxicology; (2) antibiotics; (3) steroids; (4) antimetabolites; (5) embryology and development; (6) hematopoietic system and prophyrrins; (7) lipids and carbohydrates; (8) membrane structure and functions; and (9) ground substance (mesenchyme). Lectures will be selected from the above areas and will correlate the material in terms of clinical significance. Alternate years beginning fall, 1974. (Also listed as Biochemistry 395.) 2 units. Appel, Elford, Hitchings, Kamin, Kirschner, Lack, Nichol, Posner, Rosse, and Welch

401. Metabolic and Developmental Physiology and Pharmacology. Cell division and control of the cell cycle; population dynamics; physiology of sub-cellular organelles such as nuclei, mitochondria, lysosomes, and peroxisomes; metabolic regulation with respect to temperature adaptation and variation in exogenous substrates; control of development and differentiation in eucaryotic cells. Prerequisite: Biochemistry 247 or equivalent. Fall. 3 units. Blum, Padilla, and Staff

414. Analysis of Physiological Systems. Several physiological systems analyzed in detail, using a combination of classical mathematical analysis, model-building, and newer analog and digital techniques. Topics covered include diffusion processes, steady state and transient kinetics, and cable equations. Alternate years beginning spring, 1974. 3 units. Moore, Blum, and Staff

416. Neuronal Physiology and Pharmacology. Structure and function of excitable membranes; impulse generation and conduction in different types of nerves; effects of pharmacological agents on electrical characteristics; physiological and pharmacological aspects of synaptic and neuromuscular transmission; biophysics of receptor cells. Fall. 3 units. Narahashi, Moore, Wachtel, and Wolbarsht

417. Cellular Endocrinology. Current concepts of the mechanism of action of hormones at the cellular level, including hormone-receptor interactions; secondary messengers; regulation of protein synthesis; growth and dif-

ferentiation; control of salt and water balance; regulation of substrate storage and mobilization; and modulation of hormone secretion. Fall. 2 units. Fellows and Lebovitz

418. Reproductive Biology. An in-depth survey of male and female reproductive processes including neuroendocrine, pituitary and gonadal control mechanisms, and the physiology of pregnancy and parturition. (Also listed as Anatomy 418.) Spring. 2 units. Anderson, Everett, Schomberg, and Blake

420. Cellular Immunophysiology. The interaction of immunologically active macromolecules such as antibodies or plant agglutinins with membrane surfaces and the resulting effects on membrane function and cell physiology will be the principal topic of this course. Emphasis will be placed on immune reaction mediated permeability changes in red blood cells and certain nucleated mammalian cells as well as on antibody induced alterations of enzyme activities. (Also listed as Microbiology 420.) Spring. 2 units. Lauf and Staff

422. Advanced Seminar in Endocrinology and Reproductive Physiology

I. A weekly seminar based on student and faculty-led discussions of special topics in endocrinology and reproduction. Primarily designed for advanced students with active research interests relating to these areas of mammalian physiology. Prerequisite: consent of instructor. Fall. 2 units. Fellows, Anderson, Blake, Everett, Lebovitz, Schomberg, and Staff

423. Advanced Seminar in Endocrinology and Reproductive Physiology

II. A continuation of Physiology 423 with discussion of topics not covered in the fall term. Prerequisites: Physiology 423 and consent of instructor. Spring. 2 units. Fellows, Anderson, Blake, Everett, Lebovitz, Schomberg, and Staff

Political Science

Professor Barber, Chairman (214 Perkins Library); Associate Professor Fish, Director of Graduate Studies (308 Perkins Library); Professors Ball, Braibanti, Cleaveland, Cole, Cook, Grzybowski, Hall, Hallowell, Hough, Kornberg, and Leach; Visiting Professor Palmer; Associate Professors Johns, Paletz, and Price; Assistant Professors Eldridge, Hawley, Mishler, Salamon, Spragens, Trilling, and Valenzuela; Lecturer O'Barr

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is normally expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government.

Fields in which instruction is offered currently are American government and politics (including constitutional law, public administration, the legislative and judicial processes, and state and local government); comparative government and politics (including Western Europe, Southern Asia, Latin America, Africa, the Soviet Union, and the Commonwealth); political theory; international relations (including international law and international organization); and empirical theory and methodology.

The candidates for the master's degree are required to show proficiency in one modern foreign language and to submit either a thesis or thesis equivalent. The latter option is open only to students going on for the Ph.D. degree.

The candidate for the degree of Doctor of Philosophy in political science must elect four fields, at least three of which must be selected from the fields

enumerated above and one of which must be in a related department. He must also demonstrate a reading knowledge of two foreign languages which have been approved by the professor who supervises his dissertation, or he must demonstrate proficiency in one such foreign language and in the use of statistics.

For Seniors and Graduates

206. Politics and the Media. The relationship between the media of mass communication and the American political process. 3 units. Paletz

207. American Constitutional Interpretation. Major constitutional issues approached through selected Supreme Court decisions illustrating the Court's role in the governing process. Prerequisite: Political Science 127 or its equivalent. 3 units. Fish

209. Problems in State Government and Politics. 3 units. Leach

210. The Politics of Education. The forces in local, state, and national politics which impinge on educational policy-making and administration. (Also listed as Education 210.) Not open to students who have had Political Science 313. 3 units. Leach

214. Comparative Administrative Law. Comparative analysis of the role of administrative law and administrative techniques in established and transitional constitutional systems. Emphasis on French, German, British, and American patterns. Control of legality and expediency of various types of judicial review will be discussed. 3 units. Grzybowski

220. Problems in International Politics. Among the topics considered are nuclear power, bipolarity and polycentrism, nationalism, national interests and ideology, the revolution of modernization, and regional integration. 3 units. Palmer

221. International Organization. The functioning of the United Nations system and of regional organizations operating in the political and security fields. 3 units. Ball

222. Empirical Theory. Emphasis is on the theoretical status of contemporary conceptual frameworks which often rely on or generate empirical research. Prerequisite: Political Science 233 or consent of instructor. 3 units. Trilling

223. Political Philosophy from Plato to Machiavelli. An intensive analysis of the political philosophies of Plato and Aristotle followed by a survey of medieval political thought and an analysis of the significance of Machiavelli. 3 units. Hallowell

224. Modern Political Theory. A historical survey and philosophical analysis of political theory from the beginning of the seventeenth to the middle of the nineteenth century. Attention is given to the rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism. 3 units. Hallowell

225. Comparative Government and Politics—Western Europe. Modern political institutions and processes in Western Europe. 3 units. Cole

226. Theories of International Relations. A survey of contemporary theories of international relations and foreign policy with an emphasis on the interdependence of theory and empirical research. 3 units. Eldridge

227. International Law. Elements of international law, particularly as interpreted and applied by the United States; rights and duties of states with respect to recognition, state territory and jurisdiction, nationality, diplomatic and

consular relations, treaties, treatment of aliens, pacific settlement of disputes, international regulation of the use of force, and collective responsibility. 3 units. Grzybowski

228. Soviet Public International Law. Institutions and doctrines of the international law of peace as interpreted and applied by the Soviet government. Basic concepts, including the theory of socialist international law and principle of peaceful coexistence. 3 units. Grzybowski

229. Recent and Contemporary Political Theory. The rise of positivism and its impact upon modern political thought, the origins of socialism, Marxism and its variants, socialism in the Soviet Union, Nationalism, Facism and National Socialism, Existentialism, contemporary theories of democracy. 3 units. Hallowell

230. American National Government. A study of the formation, development, and contemporary operation of the national political system. The analysis employs both historical and behavioral approaches. 3 units. Thomas

231. American Political Theory. An analysis of the main currents in American political thought from colonial beginnings to the present day. 3 units. Cook

233. Research Methodology. Measurement, causal analysis, and comparison of different levels of analysis and other problems. 3 units. Trilling

235. The Commonwealth. An analysis of the political relationship between the members of the Commonwealth and a comparative study of the political systems of the Commonwealth countries, with particular reference to Canada. A course designed in part to utilize the occasional services of visiting professors from Commonwealth countries. 3 units. Cole

236. Statistical Analysis. Introduction to statistics in political research, emphasizing inferential statistics through simple regression and correlation. 3 units. Trilling

237. Seminar in Problems in American Foreign Policy. The decision-making process as applied to contemporary foreign policy issues. (Offered in alternate years.) Prerequisite: Political Science 122 or the equivalent. 3 units. Ball

241. Public Administrative Organization and Management. An examination of the American administrative process, with emphasis upon the theory and practice of administrative organization and management. 3 units. Hall

243. Administrative and Organizational Theory. (Also listed as Public Policy Sciences 224.) 3 units. Hawley

244. Administrative Law and Process. The nature and law of the administrative process in the context of American government and politics, with special attention to the powers, procedures, and judicial control of administrative agencies. 3 units. Hall

245. Ethics and Policy-Making. (Also listed as Public Policy Sciences 223.) 3 units. Price

246. Administration and Public Policy. The role of administration in the American policy process. 3 units. Hall

247. Political Participation and Policy Outcomes. (Also listed as Public Policy Sciences 247.) 3 units. Hough

248. The Politics of the Policy Process. (Also listed as Public Policy Sciences 219.) 3 units. Salamon

249. Comparative Political Analysis and Political Development. General

methodology of comparison of political systems. Institutional, structural, functional, and configurative modes of analysis. Theories of political development. Flows of technology and social change. Theoretical problems of induced political change. 3 units. Braibanti

250. Comparative Government and Politics—Southern Asia. Political development of India and Pakistan. Contextual determinants of the political systems. Political consequences of partition. National integration, constitutional and institutional aspects of the political systems. Impact of foreign technical assistance. 3 units. Braibanti

252. Comparative Political Behavior and Socialization. Elites and mass publics in Western and non-Western societies including the United States. Models of the political socialization process and their implications for democratic theory. 3 units. Mishler

253. Comparative Government and Politics: Latin America. An analysis of current publications in comparative politics, applicable to an understanding of the major themes of Latin American politics. 3 units. Valenzuela

260. The Tradition of Political Inquiry. A study of the problems, goals, presuppositions, and methods of political inquiry, past and present. 3 units. Spragens

266. Soviet Foreign Policy. 3 units. Hough

271. Political Processes in Traditional and Modern Africa. An analysis of patterns of change in selected African societies from the pre-colonial to the post-colonial period. The focus of the course will be upon the interaction between traditional, colonial, and post-colonial institutions and their impact upon African societies. (Also listed as History 219.) 3 units. Johns

273. Modernization in the American South. 3 units. Salomon

274. Political Psychology. Psychological aspects of political performance by citizens, activists, and leaders. 3 units. Barber

275. The American Party System. An intensive examination of selected facets of American national political parties, such as relationships between presidential and congressional politics, the politics of national conventions, and the controversy over party government. 3 units. Kornberg

277. Comparative Party Politics. The impact of social and political systems on party structures, functions, ideologies, and leadership recruitment. 3 units. Kornberg

278. Canadian Political Behavior in the North American Context. Institutional processes and political behavior in Canadian and American societies. Impact of multi-partyism, federalism, political and cultural particularism, and the elite structure. 3 units. Kornberg

279. The Legislative Process. A behavioral analysis of the American legislative process with emphasis on Congress. Some consideration will also be given to legislatures in other countries. 3 units. Paletz

280. Comparative Government and Politics—Sub-Saharan Africa. Politics and government in selected African states, with particular attention to the problems of decolonization and modernization in the post-independence period. 3 units. Johns

283. Congressional Policy-Making. Roles of the executive and other "external" forces. Preconditions of innovative and independent lawmaking and committee supervision. 3 units. Price

285. The Judicial Process. A study of judicial decision-making in the

United States, with emphasis on the process of litigation, the recruitment of judges, the influences and limits on judicial decisions, and their impact within the political system. Prerequisites: Political Science 127 and 207 or their equivalents. 3 units. Fish

291. Problems of Urban Government. 3 units. Leach

293. Federalism. A study of the theoretical and operational aspects of federal systems, with emphasis in the United States, Canada, and Australia. (Offered in alternate years.) 3 units. Leach

For Graduates

303. Seminar on Selected Topics in Statistics. Introduction to the assumptions and uses of selected multivariate statistics and research methodologies including least-squares analysis, scaling techniques, factor analysis, causal inference, model-building, and computer simulation. Prerequisite: Political Science 236 or permission of the instructor. 3 units. Mishler

304. Seminar in Selected Topics in Empirical Theory. Examination of the empirical treatment of selected concepts such as power, support, and rationality. Prerequisite: Political Science 222 or 233. 3 units. Trilling

306. Seminar in Politics and the Mass Media of Communication. Prerequisite: Political Science 206 or consent of the instructor. 3 units. Paletz

310. Seminar in State and Local Government. (Offered in alternate years.) Prerequisites: Political Science 209 and 291 or their equivalents. 3 units. Leach

312. Seminar in Constitutional Law. Prerequisite: Political Science 207 or the equivalent. 3 units. Fish

313. Education and Public Policy. Seminar in the relationship of educational administration to the public policy process. (Also listed as Education 313.) Not open to students who have had Political Science 210. 3 units. Leach and Pittillo

321. Seminar in Political Theory. (Offered in alternate years.) Prerequisites: 6 units in Political Science 223, 224, 229, 231 or the equivalents. 3 units. Hallowell

325. Seminar in Comparative Government and Politics. (Offered in alternate years.) Prerequisites: 6 units in Political Science 225, 249, 250, 251, 253, 280 or the equivalents. 3 units. Cole

328. Seminar in International Law. Prerequisite: Political Science 227 or the equivalent. 3 units. Grzybowski

329. Seminar in International Regional Organization. (Offered in alternate years.) Prerequisite: Political Science 221 or the equivalent. 3 units. Ball

330. Seminar in Comparative Government and Politics—Southern Asia. Emphasis on research using documentary materials relating to India, Pakistan, Ceylon, and Malaysia. Prerequisites: Political Science 250, 251, or the equivalents. (Offered in alternate years.) Braibanti

331. Seminar in American Political Thought. 3 units. Leach

341. Seminar in Public Administration. Selected topics in administrative and organizational theory and behavior. Prerequisite: Political Science 141 or 243. 3 units

342. Seminar in American National Government and Politics. Prerequisite: Political Science 230 or its equivalent. 3 units.

343. Seminar in the Policy Process. Selected topics covering the theory,

methodology, and practice of policy formation in American politics. Prerequisite: Political Science 246 or its equivalent. 3 units

344. Workshop on Computer Models of Social Systems. (Also listed as Computer Science 344 and Economics 344.) 3 units. Naylor

360. Seminar in Government and Politics in the Soviet Union. Prerequisite: Political Science 165, or on individual approval. 3 units.

361. Seminar in Foreign Relations of the Soviet Union. Prerequisite: Political Science 220 or 360, or on individual approval. 3 units.

376. Seminar in Comparative Political Behavior. An intensive comparative examination of the impact of selected political institutions on political behavior. (Offered in alternate years.) 3 units. Kornberg

377. Seminar in Canadian Political Behavior. Analysis of institutional processes and political behavior in Canadian society with special reference to the impact of multi-partyism, parliamentarianism, political, and cultural particularism, and the elite structure. (Offered in alternate years.) 3 units. Kornberg

380. Seminar in African Government and Politics. Prerequisite: Political Science 280 or its equivalent. 3 units. Johns

381. Seminar in Latin American Government and Politics. Prerequisite: Political Science 253 or the equivalent. (Offered in alternate years.) 3 units. Valenzuela

382. Soviet Law and Society. 2 units. Grzybowski

401. Seminar in the Commonwealth. 3 units. Ball, Preston, and Others of the Committee on Commonwealth Studies

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. Goodwin, Holly, and Spragens

Related Course Work in the School of Law

There may be graduate credit for course work completed in the Duke University School of Law, under regulations referred to in this Bulletin under Academic Regulations.

Psychology

Professor Alexander, Chairman (244 Psychology-Sociology Building); Professor Staddon, Director of Graduate Studies (242 Psychology-Sociology Building); Professors Borstelmann, Brehm, Carson, Diamond, Guttman, Jones, Lakin, Lockhead, Schiffman, and M. Wallach; Associate Professors Costanzo, C. Erickson, R. Erickson, Hall, and Wing; Assistant Professors Aderman, Coie, Eckerman, Fischer, Kalat, Kremen, Norton, Robinson, Roth, and White; Lecturers Casseday, Clifford, J. Conger, E. Crovitz, H. Crovitz, I. Gehman, Gentry, Kinsbourne, Krugman, Obrist, Oppenheim, Peele, Shows, Somjen, Thompson, L. Wallach, and Wolbarsht

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, developmental, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in basic science: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which de-

scribes the program in more detail and gives information on financial assistance, facilities, and current research activity.

For Seniors and Graduates

203. Sensation and Perception. An examination of the classical concepts in sensation and perception and of the resulting psychophysical data for each of the major senses with emphasis on vision and audition. Modern perceptual formulations are discussed through analysis of the empirical evidence in support of each view. 3 units. Lockheed

204. Comparative Psychology. Ontogeny, evolution, adaptive significance, and physiology of animal behavior. 3 units. C. Erickson

210. Cognitive Psychology. Theoretical approach; stresses interconnections across perception, memory, thinking, language, and use of models. 3 units. Robinson

213. Adaptive Behavior. The principles of adaptive behavior, with special emphasis on the effects of reinforcement. Prerequisite: consent of instructor. 3 units. Staddon

215. Developmental Psychology. Theories of human development. 3 units. L. Wallach and staff

216. Biological Psychology. The methods of biology (as applied to psychology), especially in neurophysiology, neuroanatomy, and genetics. Topics covered include the genetics of behavior, the organization of the dorsal thalamus and neocortex, and the limbic system and hypothalamus. Methods covered include ablation method, method of evoked potentials, electrical stimulation of the brain, and classical and physiological genetics. 3 units. Diamond

217. Social Psychology. Social factors in cognition, models of social interaction, conformity and social influence, and attitude development and change. 3 units. Jones

218. Research Methods in Social Psychology. The theory and practice of data collection methods in social psychology. Emphasis is on the interplay between experimental design and technique. 3 units. Aderman

219. Neural Bases of Behavior. Structure and function of the nervous system as related to problems of sensory-motor processes, learning, and memory. 3 units. R. Erickson

220. Physiological Bases of Behavior. Emphasis on the neural, hormonal, and developmental bases of motivational behavior. 3 units. C. Erickson

228. Visually Guided Behavior. Anatomical and physiological maturation of the nervous system structures mediating visual behaviors. How the maturation of the visual pathway may contribute to the development of these behaviors. 3 units. Norton

234. Seminar in Personality. Selected topics of current interest concerning empirical research on personality. Strategies for the definition of research questions and the evaluation of research progress. 3 units. M. Wallach

238. Electroencephalogram and Psychological Function. A survey of experimental and clinical literature on brain wave correlates of intelligence, personality, behavior disorders, epilepsy, sleep, sensory stimulation, reaction time, and attention. Special emphasis is placed on the electrophysiology of conditioning and learning. Lectures, laboratory demonstrations, and clinical case presentations. 3 units. Obrist

239. Behavioral Correlates of Brain Damage in Man. Effects of brain damage on psychological functioning. Known brain-behavior relationships

and problems encountered in the study of brain function. Laboratory demonstrations for assessment of cerebral dysfunction through the use of standard psychological tests. 3 units. Thompson

245. Personality Theory I. Representative theories of human functioning, from Freud to neoanalytic approaches. 3 units. Alexander and Kremen

246. Personality Theory II. Representative models of human functioning, as field theory, behavior theory, type or trait theory, and ego psychology. 3 units. Alexander and Kremen

271. Seminar. Selected problems. 3 units each. Staff

273-274. Principles of Psychological Measurement. Measurement theory and the problems of scientific inference. Topics will include methods of data analysis, psychometric scaling, and test construction. Prerequisite: Mathematics 232 or equivalent. 3 units per semester. Schiffman

276. Comparative Neurology and Psychology. (Also listed as Anatomy 276.) 3 units. Hall

282. Introduction to Methods in Psychotherapy. Current trends in psychotherapeutic practice and research. Application of principles drawn from theories of personality to individual and group psychotherapy. Prerequisite: consent of the instructor. 3 units. Carson, Lakin, and Martin

283, 284. The History of Psychology. First semester, Aristotle to Kant; second semester, development of modern psychology. Prerequisite for 284; Psychology 283 or permission of instructor. 3 units per semester. Guttman

291. Seminar in Community Mental Health. Psychological epidemiology and ecology; primary, secondary, and tertiary prevention; the public health approach to problems of psychological disorders and psychological well-being. Focus on intervention techniques, such as consultation and community action planning. 3 units. Staff

293. Methods in Developmental Psychology. Methodological and epistemological issues in research in development. Individual and group research projects are an integral part of the course. 3 units. Staff

For Graduates Only

305. Psychopathology. An examination of behavior disorders, with particular emphasis on explanatory concepts and the evidence from research in this field. 3 units. Staff

306. Seminar in Developmental Psychology. Selected topics in cognitive, emotional and social development. 3 units. Staff

309. Seminar in Learning. Selected topics in operant conditioning and discrimination learning. 3 units. Staddon

310. Seminar in Perception. 3 units. Lockhead

313. Seminar on the Concept of the Reflex. A consideration of the reflexological principles found in the works of Sherrington, Sechenov, Pavlov, Eccles, Skinner, Konorski, et al., and an examination of the critiques of Goldstein, Lashley, and others. 3 units. Diamond and Guttman

314. Seminar in Instrumental Behavior. 3 units.

316. Seminar in Social Psychology. 3 units. Jones

317. Seminar in Social Behavior. 3 units.

318. Seminar in Social Influence. 3 units. Brehm

319-320. Research-Clinical Tutorial. 6 units. Staff

321. Seminar in Psychophysiology of Hearing. An examination of the relation of anatomy and physiology to psychophysics of the auditory system. Permission of the instructor. 3 units. Casseday

325. Seminar in Neuroendocrinology and Behavior. Selected problems in the study of hormones and neurohumors as they are related to such areas as reproductive behavior, sleep, and emotion. 3 units. C. Erickson

327, 328. Foundations of Clinical Psychology. A review in depth of selected issues, concepts, and empirical findings of general psychology that have immediate or potential relevance to the theory and practice of clinical psychology. The several subdisciplines such as social, developmental, and biological psychology—will be scanned so as to identify content areas that intersect with or have implications for the concerns of clinical-personality psychology. 3 units per semester. Carson and Staff

329-330. Seminar in Psychology. An intensive examination of original sources in experimental and biological psychology. Ordinarily taken by all students in the natural science division in their first year of residence. 6 units. Staff

333, 334. Seminar: Behavioral Studies of the Brain. Selected topics in the neural bases of behavior. 3 units per semester. R. Erickson

335-336. Clinical Inquiry I. This course focuses on the process of understanding intra- and inter-person systems, largely in a practicum context. 6 units. Staff

337. Seminar in Sensory Discrimination. The neural bases of discrimination in vertebrates and invertebrates is studied by neurophysiological, electrophysiological, and psychophysical techniques. 3 units. R. Erickson and Wolbarsht

340. Group Processes and Sensitivity Training. 3 units. Lakin

343, 344. Clinical Inquiry II. Intensive experience and supervision in techniques of psychotherapy and behavior modification. 3 units per semester. Staff

347-348. Personality Assessment. Introduction to the assessment of human personality through the study of personal documents, interview data, objective and projective test material. Laboratory sessions will be concerned with personality assessment of normal human subjects over extended time periods. 6 units. Alexander and Kremen

350. Practicum in Psychological Research. Ordinarily taken by all students in the natural science division in their first semester of residence. 3 units. Staff

Public Policy Sciences

Associate Professor Fleishman, Director; Assistant Professor Hawley, Director of Graduate Studies (109 Old Chemistry); Professors Estes (Medicine) and Hough (Political Science); Associate Professors Behn, Lange (Law), and Price; Assistant Professors Bell (Law), Cook, Fischer, Salomon, and Vaupel; Adjunct Assistant Professor Scheffler

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The course of study consists of a series of joint degree programs leading to the degrees of Master of Arts in public policy sciences, and a doctoral or professional degree. Such a program is designed to foster in highly trained professionals the perceptual and analytical

skills necessary for sound public decision-making. The Institute does not award independent A.M. or Ph.D. degrees.

With the exception of those individuals already possessing doctoral or professional degrees, therefore, all graduate students in the Institute must pursue a concurrent degree in another department or school at Duke, or at a nearby cooperating institution. Joint degree programs exist or are being developed between the Institute and the Schools of Law, Engineering, Medicine, and Business Administration, and with several graduate departments.

Students usually apply for the joint degree program simultaneously with their applications to the graduate departments or professional schools, or during their first or second year of advanced study. Candidates are expected to complete an equivalent of one full year of work beyond what their doctoral or professional degree would require alone.

The joint degree curriculum involves a minimum of ten courses, to be specified by the Institute. Academic work includes a four-course research sequence and a summer internship in such specialized policy areas as law and the administration of justice, communications, health, and education. This policy-research sequence, in which the student works closely with faculty in tutorial or small group situations, stresses the development of analytical skills applicable to the broad range of policy arenas.

Further information concerning specific joint degree programs may be obtained from the Director of Graduate Studies (109 Old Chemistry).

Core Courses

217. The Application of Microeconomics to Public Policy-Making. Consumption and production theory, welfare economics, theories of collective choice, market structures and regulation, and nonmarket decision-making. 3 units. Cook

219. The Politics of the Policy Process. Influence of the policy-making process on the substance of public policy. Impact of group pressures, congressional and administrative processes, and inter-governmental relations, particularly in the United States. (Listed also as Political Science 248.) 3 units. Salamon

221. Analytical Methods I: Forecasting Consequences of Policy Alternatives. The decision analysis approach as a strategy for policy-making; uses and limitations of deterministic, probabilistic, unitary, and interactive models for guesstimating the consequences of policy alternatives, including modeling techniques for structuring policy problems and statistical techniques for gathering and processing data for models. 3 units. Vaupel

222. Analytical Methods II: Appraising Consequences of Policy Alternatives. Various methods for appraising and weighing the consequences of policy alternatives, including the uses and limitations of economic utility theory, probabilistic preference theory, time preferences, multi-attribute preference trade-offs, cost/effectiveness analysis, cost/benefit analysis, scoring systems, performance indices, objective functions, indifference curves, Pareto optimality, market and shadow prices, willingness to pay consumer's surplus; concludes with a discussion of some formal decision analysis and mathematical programming. Prerequisite: Public Policy Sciences 221. 3 units. Vaupel

223. Ethics and Policy-Making. Core values and biases of policy-making in America, responsiveness and obligation among public officials, problems in the application and implementation of political norms, dilemmas of value choice and conflict. (Listed also as Political Science 245.) 3 units. Price

224. Administrative and Organizational Theory. A behavioral analysis of

public organizations with emphasis on the impact of organizational structures, individual needs and motivation, and politics on the formulation and implementation of public policy. (Listed also as Political Science 243.) 3 units. Hawley

247. Political Participation and Policy Outcomes. Impact of citizen participation upon governmental decision-making. Theoretical issues and empirical evidence (primarily American, but partly comparative). (Listed also as Political Science 247.) 3 units. Hough

258. Seminar on Aging. Policy alternatives suitable for legislative or executive solutions to the problems of aging. Sponsored jointly with the Center for the Study of Aging. 3 units. Staff

310. Analytical Methods III: Experimentation and Evaluation. Focuses on methods for monitoring and evaluating public policies. Topics include the design and implementation of social experiments to test policy options, the uses of surveys and quasi-experiments based on historical data, detecting and measuring unanticipated consequences, and the design and use of social indicators. Case studies include the negative-income-tax experiment, the health-insurance experiment, the Salk polio vaccine experiment, the National Halothane Study, the Equality of Educational Opportunity Study, and an evaluation of the U.S. Space program. 3 units. Staff

340-390. Public Policy Research Seminars. Students pursuing a Masters of Arts degree in public policy sciences are expected to take a series of five sequential courses selected from among this series which examines selected issues in specialized public policy arenas, such as: law and the administration of justice, communications, health, and education. The sequence includes a thesis seminar and a summer internship. 15 units. Staff

Religion

Professor Poteat, Chairman; Professor Young, Director of Graduate Studies (209 Divinity School); Professors Baker, Beach, Bradley, Cushman, Davies, Henry, Herzog, Lacy, Langford, Murphy, Osborn, Price, and M. Smith; Associate Professors Bailey, Clark, Kort, Meyers, Partin, Raitt, Robinson, H. Smith, Steinmetz, and Wintermute; Assistant Professors Charlesworth and Lawrence

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of three fields: (1) biblical studies; (2) historical studies; and (3) systematic and contemporary studies. They will be expected to take such courses in one or both of the other fields which will contribute to an adequate understanding of their chosen fields of specialization.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies.

This minor requirement may be fulfilled either by work in a cognate department, such as classical studies, history, political science, or sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a foundation in the academic study of religion. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only upon the satisfactory completion of the A.M. degree with the department.

FIELD I. BIBLICAL STUDIES

207. Second Hebrew. Historical Hebrew grammar with reading and exegesis of Old Testament prose (Pentateuch and historical books in alternate years). First semester. 3 units. Wintermute

208. Second Hebrew. Historical Hebrew grammar and rapid reading of prose and poetry. Second semester. 3 units. Murphy

209. Old Testament Theology. Studies of the Old Testament in regard to theological themes and content. 3 units. Murphy

223A. Exegesis of the Hebrew Old Testament: Amos and Hosea. Interpretation based upon Hebrew exegesis, stress upon hermeneutic methods. 3 units. Bailey

223B. Exegesis of the Hebrew Old Testament: Job. 3 units. Murphy

223C. Exegesis of the Hebrew Old Testament: Exodus. 3 units. Bailey

225. Living Issues in New Testament Theology. Critical examination of major problems and issues in New Testament interpretation and theology. 3 units. M. Smith

226A. Exegesis of the Greek New Testament I (Mark and Matthew). 3 units. Price or Smith

226B. Exegesis of the Greek New Testament I (Romans). 3 units. Price

226D. Exegesis of the Greek New Testament I (I and II Corinthians). 3 units. M. Smith

226E. The Gospel and Epistles of John. Exegesis of the Johannine literature in Greek. 3 units. M. Smith

227A. Exegesis of the Greek New Testament II (Luke-Acts). 3 units. Young

227B. Exegesis of the Greek New Testament II (Galatians). 3 units. Smith

227C. Exegesis of the Greek New Testament II (The Pastoral Epistles). 3 units. Young

228. The Theology of the Gospel and Epistles of John. A study of the origin of these writings; the provenance of their thought forms and symbolism; their influence on the early church; and contemporary significance. 3 units. Price

237. History of the Ancient Near East. A specialized study of the civilizations of Egypt, Palestine, Syria, and Mesopotamia in the light of biblical archaeology. 3 units. Bailey

244. The Archaeology of Palestine in Hellenistic-Roman Times. The study of material and epigraphic remains as they relate to Judaism in Hellenistic-Roman times, with special emphasis on Jewish art. Prerequisite: reading knowledge of a biblical language. 3 units. Meyers

258. Coptic. Introduction to the Sahadic dialect with selected readings from Christian and Gnostic texts. Prerequisite: at least one year of Greek. 3 units. Wintermute

302. Studies in the Intertestamental Literature. Selected documents of the Apocrypha and Pseudepigrapha examined exegetically and theologically in their relation to post-exilic Judaism. Prerequisite: permission of instructor. 3 units. Charlesworth

304. Aramaic. A study of the Aramaic portions of the Old Testament

and selected passages from the Targums, Midrashes, and Talmuds. 3 units. Meyers or Murphy

304A. Targumic Aramaic. An introduction to the language and literature of the Aramaic translations of the Old Testament. 3 units. Meyers

305. Third Hebrew. An interpretive study of late Hebrew prose, with readings from Chronicles, Ecclesiastes, and the Mishnah. 3 units. Davies or Meyers

306. Language and Literature of the Dead Sea Scrolls. A study in interpretation. Prerequisite: a knowledge of Hebrew. 3 units. Charlesworth

307. Syriac. A study of the script and grammar, with readings from the Syriac New Testament and other early Christian documents. Prerequisite: some knowledge of Hebrew and Aramaic. 3 units. Charlesworth

311. Pharisaic Judaism in the First Century. A reading course in first-century Pharisaic Judaism. 3 units. Davies

312. Pauline Theology. Studies in aspects of Paulinism in the light of recent scholarship. 3 units. Davies

314. Judaism and Christianity in the New Testament. Their interaction. 3 units. Davies

319. The Gospel According to St. Matthew in Recent Research. 3 units. Davies

323A. Comparative Semitic I. An introduction to the morphology and syntax of classical Arabic and the Semitic languages of Mesopotamia, together with a consideration of their relationship to Hebrew. 3 units. Wintermute

323B. Comparative Semitic II. An introduction to the morphology and syntax of classical Ethiopic and the Semitic languages of Palestine-Syria, together with a consideration of their relationship to Hebrew. 3 units. Wintermute

340-341. Seminar in the New Testament. Research and discussion on a selected problem in the biblical field. 3 units per semester. Price, Smith and Young

345. The Epistle to the Hebrews in Recent Research. Intensive attention to the text and to secondary sources. 3 units. Davies

350-351. Old Testament Seminar. Research and discussion on selected problems in the Old Testament and related fields. 3 units per semester. Murphy

373-374. Elementary Akkadian. Study of the elements of Akkadian grammar. Reading of neo-Assyrian texts shedding light on the Old Testament. Prerequisite: biblical Hebrew. 6 units. Bailey

375-376. Elementary Ugaritic. Study of the elements of Ugaritic. Prerequisite: biblical Hebrew. 6 units. Bailey

401. Colloquium in Biblical Studies. A colloquium in which all graduate faculty and students in the biblical division participate. Research papers in the biblical field are read and discussed.

FIELD II. HISTORICAL STUDIES

217. Islam in India. History and thought of major Indian Muslims from Biruni to Wali-Ullah, with special attention to the role of Sufism. An introduction to selected Muslim scholars and saints who contributed to the interaction between Islam and Hinduism in Northern India during the second millennium A.D. 3 units. Lawrence

218. Religion in Japan. A survey of religion in Japan, with special em-

phasis on indigenisation and attempts at synthesis. An approach to the meaning of the words religious and secular in the Japanese situation. 3 units. Corless

236. Luther and the Reformation in Germany. The theology of Martin Luther in the context of competing visions of reform. 3 units. Steinmetz

241. Problems in Reformation Theology. 3 units. Steinmetz

246. Problems in Historical Theology. Prerequisite: permission of the instructor. 3 units. Raitt

247. Readings in Latin Theological Literature. Critical translation and study of important theological texts in Latin from various periods of the history of the Church. 3 units. Steinmetz or Raitt

251. The Counter-Reformation and the Development of Catholic Dogma. Issues in Roman Catholic theology from the Reformation to the Second Vatican Council. 3 units. Raitt

260. Seminar: Wesley Studies. The lives and thoughts of John and Charles Wesley and their colleagues in relation to English culture and religion in the eighteenth century. 3 units. Baker

280. The History of Religions. A study of the methodology of the history of religions, the nature of religious experience, and specific categories of religious phenomena. 3 units. Partin

282. Myth and Ritual. Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions. Particular attention will be given to religious pilgrimage. 3 units. Partin

283. Religions of East Asia. A study of the major tradition of China and Japan, with emphasis on the development and expansion of Buddhism. 3 units.

284. The Religion and History of Islam. A study of the origins and development of the Islamic tradition and community, with particular attention to the religious element. 3 units. Partin

285. The Vedic Tradition: Its Compilation and Interpretation. A study of Indian canonical writings, with emphasis on the literary stages and relation of the writings to later philosophical and religious movements. 3 units. Lawrence

287. The Scriptures of Asia. Intensive study of translations of basic texts from the religious traditions of India, China, and Japan. 3 units. Bradley

288. Buddhist Thought and Practice. A historical introduction to Buddhist thought and practice, with special attention to their interrelationship in the living religion. 3 units. Corless

289. World Religions and Social Change. The role of religious traditions and institutions in national and international affairs. Intensive study of selected areas of Asia and Africa, with special stress on missionary religions and political change. 3 units. Bradley

296. Religion on the American Frontier. A study of the spread of evangelical Christianity as a theological and cultural phenomenon of the American West. 3 units. Henry

308. Greek Patristic Texts. Critical translation and study of selected Greek texts illustrative of significant aspects of patristic theology and history from the second through the fifth century A.D. 3 units. Young

313. The Apostolic Fathers. A study of the religious thought in the writings of the Apostolic Fathers. 3 units. Young

315-316. Seminar: History of Religions. Selected problems in the field. 3 units.

317. Seminar in the Greek Apologists. A study of the apologetic writings of the Greek Fathers in relation to the challenges of their contemporary world. Special attention will be given to leading protagonists of late Graeco-Roman culture, such as Celsus, Porphyry, and Julian. 3 units. Young

318. Seminar in the Greek Fathers. A study of selected topics from the Greek Fathers. 3 units. Young

334. Church Reformers and Christian Unity. Theology and ecclesiastical reform in the later Middle Ages. Extensive readings in Marsilius of Padua, William Ockham, Jean Gerson, Pierre d'Ailly, Nicholas of Cusa, Jan Hus, Gabriel Biel, Wessel Gansfort, and Desiderius Erasmus. 3 units. Steinmetz

335. The English Church in the Eighteenth Century. Studies of Christianity in England from the Act of Toleration, 1689, to the death of John Wesley, 1791. 3 units. Baker

336. Christian Mysticism in the Middle Ages. Source studies in historical perspective of such late medieval mystics as Bernard of Clairvaux, the Victorines, Ramon Lull, Meister Eckhart, Richard Rolle, Catherine of Siena, and Nicholas of Cusa. 3 units. Raitt

338. Calvin and the Reformation in Switzerland. The theological development of John Calvin. A comprehensive examination of his mature position with constant reference to the theology of the other reformers. 3 units. Steinmetz

339. The Radical Reformation. Protestant movements of dissent in the sixteenth century. Special attention will be devoted to Müntzer, Carlstadt, Hubmaier, Schwenckfeld, Denck, Marbeck, Socinus, and Menno Simons, 3 units. Steinmetz

344. Zwingli and the Origins of Reformed Theology. Source studies in the early Reformed tradition. 3 units. Steinmetz

384. Religious Dissent in American Culture. History and significance of dissent in the theology and culture of America. 3 units. Henry

385. Religion in American Literature. A critical study of the meaning and value of religious motifs reflected in American literature. 3 units. Henry

391. Historical Types of Christian Ethics I. A critical study of representative statements of Christian ethical theory, through the early Reformation. 3 units. Beach

392. Historical Types of Christian Ethics II. A continuation of Religion 391, from the Reformation through current Christian ethical theory. Prerequisite: Religion 391. 3 units. Beach

395. Christian Thought in Colonial America. Exposition of the main currents in Protestant theology. 3 units. Henry

396. Liberal Traditions in American Theology. A study of the main types of modern religious thought, beginning with the theology of the Enlightenment. 3 units. Henry

FIELD III. SYSTEMATIC AND CONTEMPORARY STUDIES

210. Contemporary British Theology. A study of twentieth century British theology. Attention will be given to the Anglican, Free Church, and Scottish traditions. 3 units. Langford

211. Authority in Theology. The idea and function of authority in theology. 3 units. Langford

214. The Christian Doctrine of Salvation. A systematic exposition and restatement of the historic faith of the Church in relation to representative secular alternatives of ancient and modern times. 3 units. Cushman

230. The Meaning of Religious Language. An analysis of the credentials of some typical claims of theism in the light of theories of meaning in recent thought. (Also listed as Philosophy 230.) 3 units. Poteat

231. Seminar in Christianity and Contemporary Thought. Analytical reading and discussion of such critical cultural analysis as is found in the works of M. Polanyi, Arendt, Trilling, and others, with appraisal of the relevance of theological inquiry. 3 units. Poteat

232. Religion and Literature: Perspectives and Methods. A study of literary works and their religious origins, parallels, and implications as analyzed and interpreted by myth or archetype critics and by theological critics. 3 units. Kort

233. Modern Narrative and Religious Language. A study of the fiction of selected American, British, and Continental writers of the first half of the twentieth century, with special attention to the role of religious language in their work. 3 units. Kort

245. Ethics in World Religions. Moral foundations, assumptions, and applications in such major faiths as Hinduism, Buddhism, Confucianism, and Islam, in the light of Christian ethical perspectives. 3 units. Lacy

248. The Theology of Karl Barth. A historical and critical study of the theology of Karl Barth. Prerequisite: permission of the instructor. 3 units. Osborn

249. The Church in Contemporary Theology. A critical and systematic study of the doctrine of the Church in contemporary Christian thought. 3 units. Osborn

262. Marxist Ideology and Christian Faith. Comparative examination of Communist and Christian doctrines, such as man, society, sin, history, and eschatology, together with an introduction to the contemporary dialogue. 3 units. Lacy

281. Phenomenology and Religion. Scheler, E. Strauss, Merleau-Ponty, Ricoeur, Binswanger, or others; their bearing upon religious knowledge and practice. Prerequisite: permission of instructor. 3 units. Poteat

292. Christian Ethics and International Relations. An examination of Christian attitudes toward such issues as war and peace, the rule of law, foreign aid, and human rights; and the Church's contribution to international policies and institutions. 3 units. Lacy

293. Sociological Analysis of Religion. An analysis of the way in which various components of a religion (belief-systems, liturgical practices, ethical teachings, institutional structure, and modes of operation) function in relation to social cohesion, social conflict, and social reform. 3 units. Clark

294. Institutional Analysis of Religious Bodies. A study of the internal structure and dynamics of religious groups. 3 units. Clark

295. Ethics and Economic Life. A survey of the historical teachings of the Christian churches in the areas of economic life, an analysis of contemporary norms of economic justice, and an exploration of current public and private economic policies and the policy-making processes. 3 units. Clark

300. Systematic Theology. Method and structure of systematic theology, the doctrine of God, theological anthropology, and Christology. 3 units. Cushman, Herzog, and Langford

303. The New Hermeneutic and the Idea of History. A critical examination of key thinkers in present-day European systematic theology (Fuchs, Ebeling, Moltmann, Ott, and Pannenberg) in the light of Ernst Bloch's philosophy. 3 units. Herzog

320. Hegel and Schleiermacher. A study of two makers of modern Protestant thought. 3 units. Herzog

322. Nineteenth Century European Theology. Protestant theology from Kant to Herrmann. 3 units. Herzog

325. Philosophical Theology I. Theology, as the knowledge of God, considered in dialogue with selected pagan and Christian philosophers from Plato to Kant. 3 units. Cushman

326. Philosophical Theology II. Continuation of Philosophical Theology I. 3 units. Cushman

328. Twentieth Century European Theology. Critical examination of the thought of selected Protestant theologians from 1900 to 1950. 3 units. Herzog

361. Language and Biblical Criticism. An attempt to explore the bearing of recent investigators into the nature of language upon problems in the study of biblical texts. Prerequisite: permission of both instructors. 3 units. Poteat and Charlesworth

377. Contemporary American Dramatic Arts and Evolving Theological Forms. An examination of creed and ritual implicit and explicit in contemporary American theater, film, and television. 3 units. Henry.

380. Existentialist Thought. An exploration of the interests and motifs of Existentialism in relation to modern philosophy and theology through an analysis of representative writings of Kierkegaard, Heidegger, Berdyaev, Marcel, and Sartre. 3 units. Poteat

383. Moral Theology in the Twentieth Century. Critical and comparative examination of ethical theory as exhibited in the work of selected contemporary theologians. 3 units. H. Smith

386. Christianity in Dialogue with Other Faiths. Contemporary currents of Christian thought as they affect resurgent non-Christian faiths, new formulations of a theology of mission, and ecumenical conversations. 3 units. Lacy

388. Ethics and Medicine. A critical study of selected aspects of modern biomedical technology, with special reference to the ethical assumptions informing their development and practice. 3 units. H. Smith

389. Christian Ethics and Contemporary Culture. A study of the interaction between Christian thought and current social theory. 3 units. Beach

390. Current Problems in Christian Ethical Theory. A critical study of dominant issues in Christian ethics, such as community, conscience, contextualism, power, and technology. 3 units. Beach

394. Christianity and the State. The relation of the Christian theory of the State to political problems, with special consideration of the religious assumptions underlying democratic theory and practice and of the relationship of church to state. 3 units. Beach

397. Contemporary American Theology. A critical appraisal of major tendencies. 3 units. Henry

398. Colloquium on the College and University Teaching of Religion. The theological issues of religion in higher education; a consideration of the curricular content of religion courses. Usually expected of Level III students in Fields I, II, and III in residence. Young and Staff

Romance Languages

Professor Tetel, Chairman (205 Foreign Languages); Associate Professor Vincent, Director of Graduate Studies (214 Foreign Languages); Professors Cordle, Davis, Fein, Fowlie, Niess, Predmore, and Wardropper; Associate Professors Garcí-Gómez, Hull, and Stewart; Assistant Professors Auld, Caserta, and Lan-deira

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for the A.M. and Ph.D. degree will minor in a second Romance language; however, minor work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours or (equivalent) above the intermediate level in the major language.

FRENCH

For Seniors and Graduates

209. Advanced Composition and Syntax. A systematic study of the differences between French and English patterns of expression; practice in writing various styles of French. 3 units. Hull

210. The Structure of French. Modern French phonology, morphology, and syntax. Readings in current linguistic theory. 3 units. Hull

213, 214. French Literature of the Seventeenth Century. First semester: theatre. Readings in the dramatic literature of the century. Second semester: prose and nondramatic poetry. Readings in baroque and precieux poetry, the novel and the moralistes. 3 units per semester. Auld

217. French Symbolism. The poetry and theories of Baudelaire, Mallarmé, and Rimbaud. Decadence: Lautréamont and Laforgue. Fowlie

219. Old French Literature. An introduction to the reading of Old French literary texts. 3 units. Vincent

220. French Pre-Romantic and Romantic Poetry. Chénier, Vigny, Lamartine, Musset, Hugo, and Nerval. 3 units. Niess

221, 222. The Nineteenth Century French Novel. First semester: Romanticism and Romantic Realism, studied especially in the works of Chateaubriand, Stendhal, and Balzac. Second semester: Realism and Naturalism, with special emphasis on Flaubert and Zola. 3 units per semester. Niess

223. French Literary Criticism. A history of critical theory in France and a study of the major critics from the Renaissance to today. 3 units. Fowlie

224. History of the French Language. The evolution of French from Latin to its present form; internal developments and external influences. 3 units. Hull

225. French Prose of the Sixteenth Century. Rabelais, Marguerite de Navarre, and Montaigne, and others. 3 units. Tetel

226. French Poetry of the Sixteenth Century. A critical appraisal of Villon, Marot, the École Lyonnaise, the Pléiade, and the Baroque Poets. 3 units. Tetel

228. French Poetry of the Twentieth Century. In the wake of symbolism; Valéry and Claudel; poetry as ritual, Péguy; Apollinaire and surrealist poetry; the contemporary movement, Michaux, Char, Saint-John Perse. 3 units. Fowlie

233. Contemporary French Theater. A study of dramatic theory; the art

of the leading directors; and the major texts of Claudel, Giraudoux, Anouilh, Sartre, Beckett, Ionesco, and Genet. 3 units. Fowlie

234. Proust. A study of *A la recherche du temps perdu*. The thematic structure and the aesthetics of the work. 3 units. Fowlie

241, 242. French Literature of the Eighteenth Century. First semester: the literature of the Enlightenment, including Montesquieu, Voltaire, Diderot, Rousseau, and the *Encyclopédie*. Second semester: the development of literary forms, with emphasis on the theater and the novel. 3 units per semester. Stewart

245, 246. French Literature of the Twentieth Century. First semester: to 1935, emphasis on Gide, Mauriac, and Malraux. Second semester: after 1935, emphasis on Sartre, Camus, and the *nouveau roman*. 3 units per semester. Cordle

For Graduates

311, 312. French Seminar. Each semester one of the following topics will be selected for intensive treatment: studies in sixteenth century literature, studies in eighteenth century literature, studies in nineteenth century literature, studies in seventeenth century literature, studies in contemporary literature, and studies in medieval literature. 3 units per semester. Auld, Cordle, Fowlie, Niess, Stewart, Tetel, and Vincent

—. **Graduate Reading Course.** An intensive course in French to develop rapidly the ability to read French in several fields. Graduate students only. No credit.

ITALIAN

For Seniors and Graduates

283. Italian Novel of the Novecento. Currents in Italian fiction and representative works of novelists from Svevo to the most recent trends and writers. 3 units. Caserta

284. Dante. *La Vita Nuova* and a close reading of the *Inferno*. (Conducted in English.) 3 units. Fowlie

288. The Renaissance. Petrarch, Boccaccio, and Ariosto. 3 units. Tetel

SPANISH

For Seniors and Graduates

251. The Origins of the Spanish Novel. A critical study, based on close reading and discussion, of selected examples of the principal genres of the early novel: the *Amadis de Gaula*, Diego de San Pedro's *La cárcel de amor*, the *Abencerraje*, the *Lazarillo*, Montemayor's *Diana*. 3 units. Wardropper

252. Spanish Lyric Poetry Before 1700. A critical study, based on close reading and discussion, of selected poems of the Middle Ages, Renaissance, and Baroque. Special emphasis on the *Razón de amor*, *la poesía de tipo tradicional*, and Santillana; on Garcilaso, San Juan de la Cruz, Fray Luis de León, and Herrera; on Góngora and Quevedo. 3 units. Wardropper

253. The Origins of the Spanish Theater. A study of the evolution of the Spanish theater from *Auto de los Reyes Magos* (twelfth century) through the end of the sixteenth century. The idea of the theater as dramatic poetry will be stressed; close reading of texts by Gómez Manrique, Encina, Gil Vicente, Torres Naharro, Lope de Rueda, Juan de la Cueva. 3 units. Wardropper

255, 256. Modern Spanish American Literature. First semester: poetry from Modernismo to the present. Second semester: twentieth century fiction. 3 units per semester. Fein

257. Old Spanish. The historical development of the language together with illustrative readings. 3 units. Davis

258. Old Spanish Literature. An introduction to the reading of medieval Spanish literary texts. 3 units. Davis and Garci-Gómez

259. Spanish Phonetics. A phonemic approach to the study of Spanish sounds. Remedial pronunciation drills with special emphasis on rhythm and intonation. Readings in current studies of phonology. 3 units. Predmore

260. Origins and Development of Spanish Romanticism. Representative authors, including Espronceda, Rivas, Zorrilla, Bécquer, and Rosalía de Castro, with a stress on drama and poetry. 3 units. Landeira

261. Nineteenth Century Novel. A study of literary trends in the last half of the nineteenth century. Readings will be selected from the novels of Valera, Pereda, Galdós, Pardo Bazán, Blasco Ibáñez, and their contemporaries. 3 units. Davis

262. Galdós. Works selected from the *Novelas contemporáneas*, the *Episodios nacionales*, and his drama. 3 units. Davis

265. Golden Age Literature: Cervantes. The life and works of Cervantes with special emphasis on his *Quijote*. 3 units. Predmore and Wardropper

266. Golden Age Literature: The Drama. Study of the chief Spanish dramatists of the seventeenth century with readings of representative plays of this period. 3 units. Wardropper

275, 276. Contemporary Spanish Literature. First semester: the essay and lyric poetry. A study of the revision of national values and literary expression in the twentieth century, with particular reference to the crisis of 1898 and to the enrichment of the Spanish tradition through extra-peninsular influences. Second semester: the novel. A study of tradition and innovation in the twentieth century Spanish novel with emphasis on the novels of Unamuno, Baroja, Valle, Inclán, and Pérez de Ayala. 3 units per semester. Predmore

For Graduates

321, 322. Hispanic Seminar. Each semester one of the following topics will be selected for intensive treatment: the Spanish language in America, studies in medieval literature, studies in the literature of the Golden Age, studies in Latin American literature, studies in the Spanish Renaissance and Baroque, studies in Spanish poetry, studies in nineteenth century Spanish literature, and studies in twentieth century literature. 3 units per semester. Davis, Fein, Garci-Gómez, Landeira, Predmore, and Wardropper

ROMANCE LANGUAGES

218. The Teaching of Romance Languages. Evaluation of objectives and methods; practical problems of language teaching at the elementary, secondary, and college levels; analysis of textbooks, tests, and audiovisual aids; applied linguistics. 3 units. Hull

Slavic Languages and Literatures

Associate Professor Krynski, Chairman (314 Foreign Languages); Associate Pro-

fessor Jezierski, Director of Graduate Studies (321B Foreign Languages); Associate Professor M. Pavlov

The Department of Slavic Languages and Literatures inaugurated in 1971 a graduate program leading to the A.M. degree. Initially, graduate students will be able to major only in Russian language and literature, but there will be limited training in the language and literature of Poland.

Applicants should have sufficient undergraduate preparation in the Russian language to enable them to read Russian classical literature in the original.

For Seniors and Graduates

201, 202. The Novelists of Nineteenth Century Russia. Development of the Russian novel against the European background, with emphasis on Dostoevsky and Tolstoy. Extensive readings in English. 3 units per semester. Krynski

205. The Structure of Polish in Relation to Russian. Comparative and contrastive study of the two major Slavic languages. Considerable emphasis placed on preparing students to read Polish literary texts. 3 units. Krynski

206. Readings in Contemporary Polish Prose in the Original. Stylistic analysis of aphoristic prose by Stanislaw Lec, philosophical allegories by Leszek Kolakowski, and short stories by Slawomir Mrozek and Marek Hlasko. 3 units. Krynski

207. Soviet Literature and Culture. Literature since 1917. Readings in English or Russian from major works of prose, poetry, and drama. 3 units. Jezierski

209. Readings in Contemporary Polish Prose in the Original. Stylistic analysis of short prose by Brandys, Rozewicz, Andrzeyewski, and others. 3 units. Krynski

212. Pushkin. A survey of his life and works, with attention given to his role as a precursor of modern Russian Literature. Readings in English or Russian. Prerequisite: Russian 101 or consent of the instructor. 3 units. Krynski

213. The Slavs: Literature and Culture, 1918-1939. Study of the culture of the Soviet Union, Poland, and Czechoslovakia using representative literary masterpieces. Comparison with Western European trends. Readings in English. 3 units. Krynski

214. The Poles: Literature and Culture, 1940-1970. Study of the culture of Poland using representative literary masterpieces. The international context with emphasis on Western literary avant-garde and Soviet political influences. Special attention to Jewish themes. Readings in English. 3 units. Krynski

215, 216. Advanced Composition and Syntax. A detailed study of the morphological and syntactic structure of modern Russian. Compositions based on literary topics. Prerequisites: Russian 91, 92 or instructor's permission. 3 units per semester. Pavlov

***224. The Russian Short Story—Eighteenth Century to the Present.** Readings of stories by such masters of the genre as Pushkin, Gogol, Turgenev, Tolstoy, Dostoevsky, and Chekhov. Readings in English and in Russian. 3 units. Jezierski

225. Tolstoy. A study of his life and works. The novels, short fiction, plays, and other writings considered in the light of his world significance. 3 units. Jezierski

*Not offered in 1974-1975.

***227. Gogol.** Life and works: short stories, dramas and the novel. Readings in English and in Russian. 3 units. Jezierski

230. Chekhov and the Russian Prose of the Turn of the Century. Structural analysis of Chekhov's short stories and plays against the background of contemporary Realist, Impressionist, Symbolist, and Decadent trends in Russian prose. 3 units. Krynski

232. Dostoevsky. A close examination of his major fiction. 3 units. Jezierski

***236. Russian and Polish Romanticism.** Prose, poetry, and drama of such major writers as Pushkin, Lermontov, Mickiewicz, and Krasinski presented against the background of the Romantic movement in Western Europe. 3 units. Krynski

Sociology

Professor Kerchoff, Chairman (268 Sociology-Psychology Building); Associate Professor Wilson, Director of Graduate Studies (271 Sociology-Psychology Building); Professors Back, Maddox, McKinney, Myers, Palmore, Preiss, Roy, Smith, and Tiryakian; Associate Professor Simpson; Assistant Professors Brehm, Hirschman, and House

The department offers graduate work leading to a Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admission should submit scores on the Graduate Record Examination, especially the Aptitude Test.

Candidates for the Ph.D. degree in sociology are expected to demonstrate in qualifying and preliminary examinations a broad background in the various aspects of sociology—substantive, theoretical, and empirical. The program of each candidate is determined by a committee which reviews his previous work and sets the specific requirements to be met. These requirements will include work in related fields such as anthropology, economics, mathematics, philosophy, political science, or psychology. Emphasis is placed on the completion of the dissertation, directed by a member of the staff, demonstrating competence and independence in the investigation of an original and significant problem.

Further details of this program, the departmental facilities, the staff, and various stipends available, are described in a brochure which may be obtained from the Director of Graduate Studies.

For Seniors and Graduates

225. Medical Sociology. A review and critique of current issues in the organization and development of resources for health care and of factors associated with the utilization of these resources. 3 units. Maddox

241. Social Stratification. The nature of hierachial and vertical differentiation in the economic, political, and prestige structures in modern societies. The interrelationship of class, status, and power strata and their influence on social institutions, personality structure, and group and individual behavior. The transmission of inequality from one generation to the next. 3 units. Mason and Roy

242. The Sociology of Occupations and Professions. The social significance of work. Analysis of forces changing the contemporary occupational

*Not offered in 1974-75.

structure, typical career patterns of professions and occupations, the social organization of occupational groups. 3 units. Simpson

243. Population Dynamics and Social Change. Introduction to demographic analysis. The relationship between the demographic structure of society and its social organization. 3 units. Myers

247. Community and Society. This course seeks to provide a frame of reference for the analysis and ordering of facts pertaining to the diverse cultures of the world, the State, the world community, the Great Society, news, mass behavior, social problems, races, and classes. 3 units. Staff

251. The Sociology of Modernization. Changes, obstacles to change, and structural strains which occur in kinship, stratification, bureaucracy and the role of the military, occupations and work, communications, and values and ideologies, during modernization. 3 units. Hirschman and Tiryakian

253. Social Institutions. The study of particular institutions and the social movements out of which they developed, with emphasis on the development of general propositions concerning the nature, function, and importance of institutions in society. 3 units. Staff

255. Race and Culture. A comparative study of race relations in world perspective developed around such themes as races and personal identity, the geography and ecology of race relations, the idea of race, and race conflict. 3 units. Hirschman and Palmore

259. Religion and Social Change. A study of the role of religion in significant social changes in Western and non-Western societies. Emphasis given to non-institutional phenomena (charisma, prophecy, messianism, revivals, glossolalia). Prerequisite: Anthropology 264 or Sociology 151, or the equivalent. 3 units. Tiryakian and Wilson

272. The Socialization Process. A consideration of the universal societal requirement for replacement of socialized personnel with major concentration on the process in Western society. Particular attention is given to variations in socialization by position in the social structure (class, caste, urban-rural) and to the contributions made by various socialization agencies (family, school, peer groups, mass media). 3 units. Kerckhoff

275. Social Attitudes and Individual Behavior. Such issues as the following are considered: the importance of symbolic interaction, the development of the "self," the social structuring of the socialization process, individual movement within the social structure, and the importance of membership groups and reference groups. 3 units. Back and House

278. Social Structure and the Life Cycle. A study of the relationship between age as a social characteristic and social interaction, with particular reference to adolescence and old age. 3 units. Maddox

295. Methodology in Sociology. Considerations of the nature of scientific method, as well as alternative paths to knowledge, as they apply to sociology. Conceptualization, hypothesis formation, and definition. The research process as a decision-making situation both on the general level of research design and the specific level of special techniques. The process and logic of data analysis. Relations of theory and research are stressed. 3 units. Back and Smith

297. Statistical Analysis in Sociology. Such techniques as zero and higher order linear and curvilinear correlation, partial correlation, analysis of variance and covariance and factorial design are studied. Where possible, analogous nonparametric techniques are also considered. 3 units. Brehm

298, 299. Seminar in Selected Topics. Substantative, theoretical, or methodological topics. 3 units each course. Staff

For Graduates

301. Seminar in Human Fertility. Special topics in human fertility including: theory of demographic transition, fertility in Latin America, design and evaluation of family planning programs, fertility and problems of modernization, and family structure and fertility. 3 units. Back

302. Seminar in Migration. Special topics in migration including: Latin American rural-urban migration, urban migration policy, contemporary migration theories, and international migration. 3 units. Myers and Smith

325. Social Aspects of Mental Illness and Treatment. An examination and critique of sociological research and theory in the epidemiology, etiology and treatment of mental illness. Such topics as the effect of mental illness on the family, the structure and function of various treatment systems, and major problems of methodology will receive emphasis. 3 units. Back and Preiss

341. Special Problems of Complex Systems. Industrial and Professional Systems. Analysis of problems of organization of work in such diverse settings as industrial plants, hospitals, and public administration groups. Problems of decision-making, recruitment, allocation of authority, informal organization, inter-organizational relations. 3 units. McKinney and Roy

Mass Communications. Theoretical problems in defining and distinguishing communication, communicative acts, communication processes, and communication systems. Work aimed toward the derivation of models and theories for each of these will be pursued. Students must have permission of the instructor. 3 units. Smith

Urban Society. Analysis is made of the varying mechanisms through which urban society is integrated, how urbanites develop a sense of identification with the community, and the extent and mode of social dominance of the city in the larger society. 3 units. Myers and Smith

Human Ecology. An examination of such issues as the logic and utility of the ecological approach; the possibility of testing current ecological theories in non-Western, non-urban environment; alternative explanations for the spatial patterning of social phenomena; selected methodological problems. 3 units. Myers and Smith

344. Workshop on Computer Models of Social Systems. The methodology of building mathematical and logical models of social systems and computer simulation experiments with such models. The types of models and social systems surveyed have applications in business administration, economics, education, political science, psychiatry, psychology, and sociology. Participants in the workshop will develop and conduct simulation experiments with a model of some complex social system, such as a city, state, region, or nation. 3 units. Naylor

345, 346. Demographic Techniques I and II. Measurement and methodology in demography. The first course will deal primarily with basic measurement techniques including standardization, construction of the life table, period and cohort measures of fertility, and introduction to classical population theory. The second will be devoted to the analysis of complex models such as family building models and growth and projection models and the preparation of a research topic. 3 units per semester. (Also listed as Economics 345, 346.) Myers

351, 352. Seminar in Social Organization. Examination of such problems as the bases of social cohesion and continuity, the sources and effectiveness of social control mechanisms, the problem of social change in structural-functional theory. 3 units per semester. *Maddox and McKinney*

361. Seminar in Comparative Sociology. Major emphasis on the relevance of evolutionary, functional, and structural theories for explaining the findings of comparative studies. 3 units. *Hirschman, Myers, and Smith*

373, 374. Social Psychological Issues in Sociology. Detailed exploration of selected problem areas such as the theory and measurement of social attitudes, role discontinuity and personality disorders, applications of reference group theory, the socialization process. 3 units per semester. *Back, Kerckhoff, and Preiss*

381. Development of Sociological Theory. An analysis of the development, convergence, and utilization of sociological theory. 3 units. *McKinney, Tiryakian, and Wilson*

385. Seminar in Sociological Theory. Analysis of methodological and substantive problems in utilizing comprehensive, middle-range, and discrete theories in varied sociological areas. Major emphasis on the use of theory in empirical research. Prerequisite: Sociology 381 or equivalent. 3 units. *McKinney*

386. Seminar in Sociological Theory. Focuses on the theoretical and research implications of existential phenomenology, drawing from such sources as Husserl, Merleau-Ponty, and Schutz. Attention will be given to recent sociological interests in this area (e.g., ethnomethodology). Prerequisite: Sociology 381 or equivalent. 3 units. *Tiryakian*

390. Seminar in Field Methods of Sociological Research. The primary aims of this course will be two-fold, (a) to consider at length and in detail various procedures and problems of observing human behavior in natural group, organizational, and community settings, and (b) to give the neophyte researcher elementary training in first-hand observation and face-to-face interviewing. 3 units. *Roy and Schneller*

392. Individual Research in Sociology. Students will conduct on an individual basis research designed to evaluate a sociological hypothesis of their choice. The process must be completed by preparation of a report on this research in adequate professional style. Prerequisite: Sociology 295 or permission of the instructor. 3 units. *Back and Smith*

397, 398. Seminar in Special Research Problems. Treatment in depth of either selected methodological issues and/or methods. Examples of possible topics include scaling, methods of machine data processing, validation and induction, theory construction, quantification, interviewing, measurement, sampling plans, development of research designs from statistical models, methodological research, experimental techniques, demographic techniques, the relation of theory to research, and the role of statistical methods in sociology. Prerequisite: permission of instructor. 3 units each semester. *Staff*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

Zoology

Professor Fluke, Chairman (227 Biological Sciences Building); Associate Pro-

fessor Wainwright, Director of Graduate Studies (024 Biological Sciences Building); Professors Bailey, Bookhout, Costlow, Gillham, Gregg, Klopfer, Livingstone, Nicklas, Schmidt-Nielsen, Tucker, and K. Wilbur; Associate Professors Barber, Vogel, and Ward; Adjunct Associate Professor Schmidt-Koenig; Assistant Professors Bergeron, Forward, Lundberg, McClay, Sutherland, and H. Wilbur

The Department of Zoology manages a variety of programs tailored to individual needs to students seeking A.M. or Ph.D. degrees.

In general, a student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the Bulletin of Undergraduate Instruction and the Bulletin of the Graduate School for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

For Seniors and Graduates

201. Animal Behavior. Emphasis on recent physiological and developmental studies. Prerequisites: physiology, genetics, and evolution, or consent of instructor. Usually taught on a tutorial basis. 3 units; 4 units with laboratory. Klopfer

202. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lectures and laboratory. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. Salmon

203. Marine Ecology. Ecological processes as exemplified by marine organisms; environmental factors, intra and interspecific relationships; community ecology. Readings, discussion, written papers, and computer use. Field projects using modern methods. Prerequisites: a course in general biology, invertebrate zoology or the equivalent, and a year of mathematics, some knowledge of statistics would be helpful. (Given at Beaufort.) 6 units. Sutherland

204. Population and Community Ecology. Theoretical ecology emphasizing the evolution of life cycles, mathematical properties of systems of interacting species, and mechanisms of species interactions. Laboratories emphasize biometrical and experimental testing of ecological theory in relation to a variety of habitats. Individual projects and weekend field trips. Prerequisites: Zoology 103, calculus, senior or graduate standing, or permission of instructor. 4 units. H. Wilbur

205. Elements of Theoretical Biology. An introduction to elementary mathematical biology, conceived as the study of axiomatized mathematical theories and their biological models. Prerequisites: introductory college biology and mathematics, or consent of instructor. 3 units. Gregg

214. Biological Oceanography. Composition in time and space of marine biosphere in relation to descriptive marine chemistry, physics, and geology.

Some work at sea aboard the research vessel. Prerequisite: chemical oceanography or permission of instructor. (Given at Beaufort.) 6 units. Barber

216. Limnology. A study of lakes, ponds, and streams, including their origin, development, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities living in them. Lectures, field trips, and laboratory work. Usually offered in alternate years. Prerequisites: introductory college biology, chemistry, physics, and Mathematics 31, or permission of instructor. 3 units; 4 units with laboratory. Livingstone

218. Paleobiology. Readings, discussions, and lectures on the dynamics of past ecosystems; climatology and ecological geography of the past few million years; laboratory study of lake beds with emphasis on Quaternary pollen grains. Prerequisites: consent of the instructor and a course in ecology. 4 units. Livingstone

224. Vertebrate Zoology. A study of life histories, adaptations, ecology, and classification of vertebrate animals. Prerequisite: Zoology 56. 4 units. Bailey

229. Morphogenetic Systems. Lectures on the interplay of theory and experiment in twentieth century developmental biology. Prerequisite: introductory biology. 3 units. Gregg

236. Human Genetics. See course description for Anatomy 236. (Also listed as Anatomy 236, Anthropology 236, and under the Genetics Program.) 3 units.

238. Systematic Zoology. The fundamental theory and practice involved in the collection, identification, and classification of animals. Prerequisite: college biology. 4 units. Bailey

239. Biogeography. Seminar. Old and new distributional concepts of animals and plants involving physical geography, geology, paleontology, systematics, evolution, population dynamics and dispersal. Prerequisite: permission of the instructor. 3 units. Bailey

245. Radiation Biology. Actions of ionizing and excitational radiations on life processes; biological use of radioactive tracers; nucleonics. Prerequisites: college physics, mathematics, and chemistry. 3 units; 4 units with laboratory. Fluke

246. Physical Biology. Physical principles of structure and function in large biological molecules and aggregates, applications to function at higher levels of organization, and to biological fitness. Prerequisites: college mathematics, chemistry, physics, and one biology course beyond the introductory course, or consent of instructors. 3 units. Fluke and Wainwright

248. Introductory Biochemistry. For description, see Biochemistry 247. (Also listed as Biochemistry 247 and Botany 248.) 3 units. Sage (Biochemistry)

250. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Given at Beaufort.) 6 units. Forward

252. Comparative Physiology. The physiological mechanisms of animals studied on a comparative basis. Prerequisite: Zoology 151 or equivalent. 4 units. Schmidt-Nielsen

254. Fluid Flow and Living Systems. Seminar. Physical principles of low speed flow; applications to locomotion, circulation, dispersal, ventilation, filtration, and heat dissipation. Prerequisites: college physics and Mathematics 31 or equivalent. 3 units. Vogel

258. Laboratory and Research Methods. Radioisotope methods, spectrophotometry, light microscopy, transmission and scanning electron microscopy, X-ray diffraction, gel electrophoresis, isolation of cell components, and other methods. Students may select methods according to their interests and research needs. Prerequisite: consent of the instructor. Credits to be arranged. 1-4 units. K. Wilbur and Staff

260. Advanced Cell Biology. Structural and functional organization of cells and their components, emphasizing current research problems and prospects. Prerequisites: introductory cell biology or genetics with permission of instructor; introductory biochemistry recommended (may be taken concurrently). 3 units. Nicklas, K. Wilbur, and Staff

262. Cytological Materials and Methods. General cytological analysis, with emphasis on chromosome studies using optical, cytochemical, and experimental techniques. Prerequisite: Zoology 160 or 260 or equivalent (may be taken concurrently). 2 units. Nicklas

266. Topics in Cell Structure and Function. Advanced discussions of selected problems such as chromosome structure, mitosis and cytological aspects of inheritance and development. Prerequisites: Zoology 160 or 260 or equivalent and permission of the instructor. Alternates with Zoology 288. (Also listed as Anatomy 266.) 2 units. Nicklas and Moses (Anatomy)

274. Marine Invertebrate Zoology. Structure, functions, and habits of invertebrate animals under normal and experimental conditions. Field trips will be made to study, collect, and classify animals in their natural habitats. Prerequisite: college biology. (Given at Beaufort.) 6 units. Staff

275. Invertebrate Zoology. Lectures, readings, and laboratory work dealing with free-living and parasitic invertebrates. Field trips to freshwater and marine habitats. Not open to students who have had Zoology 173, 174 or 274. Prerequisite: college biology. 4 units. Bookhout

277. Endocrinology of Marine Animals. Control of growth, regeneration, reproduction, metabolism and other aspects of physiology of marine animals, primarily invertebrates. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. Hagadorn

278. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. (Given at Beaufort.) 6 units. Bookhout

280. Principles of Genetics. See course description for Botany 280. (Also listed as Botany 280 and under the University Program in Genetics.) 3 units. Boynton (Botany), Gillham, and Others of the University Program in Genetics

286. Evolution. Processes of adaptation and evolution in individuals, populations, and genetic systems. (Also listed as Botany 286 and under the University Program in Genetics.) Not open to students who have had the courses previously numbered Zoology 109 or Botany 240. Prerequisite: a course in genetics or consent of the instructor. 3 units. Antonovics (Botany), Lundberg, and H. Wilbur

286L. Evolution. Same course as 286 except laboratory included. 4 units. Antonovics (Botany) and Lundberg

288. The Cell in Development and Heredity. See course description for Anatomy 288. (Also listed as Anatomy 288 and under the University Program in Genetics.) 2 units. Counce (Anatomy), Gillham, and Staff

295, 296. Seminar. Topics, instructors, and course credits announced each semester. 1-3 units. Staff

351, 352. Departmental Seminar. A weekly meeting of graduate stu-

dents and faculty to hear and discuss research reports. 1 unit credit by arrangement. Staff and Invited Lecturers

353, 354. Research. To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. Staff

355, 356. Seminar. One or more seminar courses in particular fields are given each semester by various members of the staff. These will be in the fields indicated in Zoology 353, 354. 2 units. Staff

360, 361. Tutorials. Students will write essays based on reading of literature. Essays will be discussed and critically evaluated in meetings. 2 units per semester. Staff

Genetics, The University Program. Genetics courses offered by the Department of Zoology are part of The University Program in Genetics; see announcement in this Bulletin.

Marine Laboratory. The following courses are given at Duke University Marine Laboratory, Beaufort, N. C.: 202, Introduction to Comparative Behavior; 203, Marine Ecology; 214, Biological Oceanography; 240, Chemical Oceanography; 250, Physiological Ecology of Marine Animals; 274, Marine Invertebrate Zoology; 276, Comparative and Evolutionary Biochemistry; 277, Endocrinology of Marine Animals; 278, Invertebrate Embryology. Consult Marine Sciences in this Bulletin for other offerings at the Duke University Marine Laboratory.

Program in Tropical Biology. Fellowships are available for travel and subsistence in field-oriented programs in Latin America. Refer to the section Organization for Tropical Studies in this Bulletin in the chapter on Special and Cooperative Programs.

Appendix

ADVANCED DEGREES CONFERRED MAY 13, 1973

Master of Arts

Adams, Linda LaMarsh	Hatting, Steven Hugh	Pfeifer, Kenneth Arthur
Anderson, Jeffrey Carr	Herbert, Jerry Scott	Porter, Richard Edwin
Baruch, Zdravko	Hirasawa, Katsuei	Regan, Thomas G.
Berner, Carol Anne	Holden, Timothy Robert	Roll, Virginia Lynn
Bisson, Terrence Paul	Hume, John Chandler, Jr.	Schatzel, Jane DeWolf
Boback, Douglas Stephen	Irani, Golnaz	Seitzinger, Michael Vaughn
Brauner, John Frank	Jones, Clarence Dupre, III	Short, Larri Alexis
Brown, Robert Warren	Kalinevitch, Karen Lynn	Shugart, James Walter, III
Clow, Harvey Kennedy	Kavanagh, Patrick Joseph	Simpson, Richard T.
Conroy, Joseph Lawrence	Lih, Ko-Wei	Sizemore, Richard William
Crossley, Ross William	Little, Shad Keys	Speedy, John Clark, III
Crowell, Lorenzo Mayo, Jr.	Loveland, Christine Ann	Stokely, Dykeman Cole
Deering, Karen Rowley	Maafo, Eugene Victor Amakye	Swain, Richard Moody, II
Dorf, Martin Edward	McCormick, Rodney Ivan	Trent, Alex W.
Eiford, Crayon Cornelius, Jr.	Miller, James Joseph	Van der Ploeg, Stephen S.
Egan, Maurice Michael, Jr.	Moore, Richard Sinclair	Wallace, Barbara Kurtz
Epperson, Bonnie Jean	Morris, Stephen Brent	Warren, Robert Burton
Faruqi, Ashraf	Moses, Arthur Laurence	Weistroffer, Heinz Roland
Goedde, Alan George	Murphy, Philip Joseph	Williams, Virginia Parrott
Graver, Anne Hayward	Neild, Frank Rollinson, II	Winders, James Arthur
Grothey, Mina Jane	Ninestein, Eleanor Hunter	Wright, Robert Scheffel
Gulliksen, Sharon Rose	Olson, Ronald W.	Yates, Patricia Haim
Hargrove, Pinckey T.	O'Rourke, Timothy G.	Zelenka, James Edward
Hatcher, Andrew Harvey	Owen, Jan Scott	Zusselman, Janet Diane

Master of Arts in Teaching

Barton, Martha Ruth	Elebash, David Hunley	Rettig, William Terence
Carriker, Marvin Leonard, Jr.	Fraker, Elizabeth Loftus	Schloesing, Christine Jacqueline
Casey, Benjamin Earl	Hart, Mary Lou Virginia	Steahly, Linda Anne
Chenoweth, Anne Starr	Linsley, Jennifer Wallace	Touchton, Cathleen R. Deppe
Dutton, John Coatsworth, Jr.	Lucas, Guy Boyd	

Master of Education

Blei, Jan	Fowler, Lynn Rose	Perry, Josephine Charlotte
Butler, Cathy Louise	Hayes, James McDonald	Rhodes, Nancy L.
Cecil, Gerald T.	Kehoe, Anna Karina	Roseborough, Morgan Garrott, Jr.
Chummar, Mary Kutty	Kerr, Mary Margaret	Sanders, Caroline Robinson
Coogan, Judy Johnson	Lohner, Christian M.	Schwartz, Thomas Allen
DeMik, Harry Edward	Markert, Frederick John	Sexton, Mary Ellen
Eisenhardt, William Baldwin	McFaren, Freddy E.	Sorrels, Ann Thompson
Fleming, Ronald James	McNamara, Mary Ellen	Walker, Emily Elizabeth

Master of Science

Ahuja, Pratap	Hasit, Yakir	Nissen, James Arthur
Albano, Ralph C.	Hedgecock, Ralph Edward, Jr.	Parker, Richard Dennis
Barnard, Edward Livingston	Herbert, Margaret Ellen	Patterson, Marvin
Bell, Noel James, Sr.	Hildebrandt, William Henry	Patton, Carol Breedon
Bochan, Richard Allen	Hiltebeitel, Edith Berg	Pegg, Jabez Gilbert
Breitweiser, Robert Allen, Jr.	Hodgkiss, William Seales, Jr.	Sheppard, William Francis
Cook, Thomas Michael	Khan, Subhotosh	Smith, Robert
Couture, Edward Anthony	King, George Wayne	Southerland, Sydney Duane, Jr.
Derr, Henry Reirden	Kohler, Johann R.	Stitt, John Edward
Eaton, John Edwin	Lalor, Robert Peter	Sweitzer, Ronald Ward
Ellingson, Dennis M.	Lenz, James Emmett, Jr.	Thompson, George Braxton, Jr.
Emerich, Marilyn Ruth	Lesher, Dana Douglas	Thompson, Jeffrey Clinton
Frazier, Dwight Moody, Jr.	Ling, Moses More-See	Tucker, Allen Eugene
Frazier, Keith Vernon	Mann, Charles Edward	Waldruff, John Lawrence
Giffin, Carole Ann	Maxson, Frederick Gordon	Weiss, Thomas Hayward
Hanson, John Bill	Monson, Dennis Eric	Wonnacott, William Curtis
Harrison, Larry Don	Murphy, Cornelia Joan	Yundt, Karen Joyce

Master of Business Administration

Bagwell, David Spurgeon	Hitchens, James Robert	Papachristou, Constantine George
Bonnifield, Lee Delos	Kemp, James Donald	Perry, Douglas Scott
Brams, John Brian	Love, Walter Richard, Jr.	Ramaswamy, Krishna
Butler, Michael Edmund	Nicoll, William MacRae	Reagan, Ronald James
Despoines, Philippe Huyghues	Palmer, William Charles	Saranath, M. P.

Master of Hospital Administration

Abbott, William Slocum
Bash, Robert Ronald
Bonhag, Robert C.
Burnette, Donald Eugene
Butterfield, Bunnee Ann
Escueta, Franklin Thomas
Hannon, Francis Joseph

Harmelink, Thomas Maurice
Livengood, Richard Vaughn
Lunn, Robert Otis, Jr.
McCracken, Roy Charles
Miller, Jeffrey Stranahan
Miller, John Alton, Jr.
Oden, John R.

Paugh, James William
Schultz, Thomas William
Singleton, John Knox
Soule, Frederick Lewis
Tannenbaum, Jeanne Louise
Taylor, Warren Ellsworth
Yasinski, Andrew Martin

Doctor of Education

Clark, Gary Alvin (B.S., Appalachian State University; M.Ed., University of North Carolina). Education. Dissertation: "Budgetary Authority of Public High School Principals in North Carolina."

Collins, Rhoda Powers (A.B., M.Ed., University of North Carolina). Education. Dissertation: "A Study of Pre-service Teacher Change During Student Teaching."

Cooke, Harry Lee (B.S., A.M., Appalachian State University). Education. Dissertation: "Characteristics of Part-Time Instructors in Comprehensive Community Colleges of North Carolina."

Farror, Sarah Jerome (A.B., Greensboro College; M.A.T., Duke University). Education. Dissertation: "State Control of the Social Studies Curriculum."

Ferguson, Donald Ellis (B.S., Southern Illinois University; M.S., Purdue University). Education. Dissertation: "An Operational Input Analysis Model to Facilitate the Implementation of the Planning-Programming-Budgeting System in Local School Districts."

Foust, Betty Jean (B.S., East Carolina University; M.E., University of North Carolina). Education. A project was accepted in lieu of a dissertation.

Jones, Robert Ralph (B.S., North Carolina State University; M.A.T., University of North Carolina). Education. Dissertation: "The Effect of the Emergency School Assistance Program on Racial Attitudes of Selected Secondary School Students in North Carolina."

Morgan, Jennifer Wright (B.S., Columbia College; M.S., University of Tennessee). Education. Dissertation: "The Differences Between Underachieving Institutionalized Male Delinquents and Nondelinquents as Measured by Psychological Tests, Scales and Inventories."

Murray, Rebecca Jean (A.B., Meredith College; M.Ed., University of North Carolina). Education. Dissertation: "The Development of the Kindergarten Program in the Public School System of North Carolina."

Shook, Mollie Wiggins (A.B., Wake Forest University; M.A.T., Duke University). Education. Dissertation: "Changing the Racial Attitudes of White Students Toward Blacks, Using Commercially Produced Films."

Smith, Ruth Suessmuth (A.B., University of North Carolina; A.M., East Carolina University). Education. Dissertation: "A Study of the Effect of Programmed Tutoring in Reading on the Reading Achievement of Selected First Graders in Nash County."

Stevens, Barbara Carr (B.S., Atlantic Christian College; M.Ed., University of North Carolina). Education. Dissertation: "A Study of Inservice Teacher Characteristics."

Walser, Wesley Max (A.B., Brevard College; M.Ed., M.A.T., University of North Carolina). Education. Dissertation: "Environmental Education, Kindergarten Through Grade Twelve: A Resource Guide for Teachers."

Doctor of Philosophy

Adams, Richard Erlend (A.B., Hillsdale College; A.M., Duke University). Sociology. Dissertation: "Education and Attitudes Toward the Family in India: A Study in Visakhapatnam, Andhra Pradesh."

Afghahi, Mohammad Hossein (Licentiate, University of Tehran). Mathematics. Dissertation: "On the Rate of Convergence in the Central Limit Theorem in Two Dimensions and Its Application."

Ahmann, Gerald Black (A.B., Duke University). Biochemistry. Dissertation: "The Binding of Lectins to Lymphocytes and Its Relationship to Stimulation."

Alexander, Ann Field (A.B., Mary Baldwin College; A.M., Duke University). History. Dissertation: "Black Protest in the New South: John Mitchell, Jr., (1863-1929) and the Richmond Planet."

Armistead, Jack Murray (A.B., Michigan State University; A.M., Duke University). English. Dissertation: "A Study of Structure and Poetics in Dryden's *The Hind and the Panther*."

Arroyo, Edward Benjamin, Jr. (A.B., Spring Hill College; A.M., Duke University). Sociology. Dissertation: "Co-responsibility and Ministry: Participative Management and Its Effectiveness in Religious Organizations."

Ashley, Kathleen May (A.B., A.M., Duke University). English. Dissertation: "The Idea of Order in the Towneley Cycle."

Ashley, Lawrence Raymond (A.B., University of Chicago). Philosophy. Dissertation: "Personal Identity: Historical and Analytical Considerations."

Baker, Catherine (A.B., Mount Saint Agnes College; A.M., Duke University). Chemistry. Dissertation: "Infrared and NMR Spectral Studies of Probe and Solvent Interactions in Pure and Mixed Solvents."

Ball, Revonda Jean (A.B., Lehigh University; M.A.T., Duke University). Education. Dissertation: "An Examination of the Current Threat of Dismissal of Public High School English Teachers Because of Controversy About Selected Reading Materials and Suggested Activities for Teachers."

Beauchamp, Charles Oliver, III (A.B., Stanford University). Biochemistry. Dissertation: "Studies on Superoxide and Superoxide Dismutase."

Bell, Linda Lee Green (A.B., Oberlin College; A.M., University of Texas). Psychology. Dissertation: "Influence of Need to Control on Differences in Attribution of Causality by Actors and Observers."

Brantley, Helen Thomas (A.B., Duke University). Psychology. Dissertation: "A Study of Motoric Variables and Their Relationship with Intellectual and Personal Adjustment Characteristics of Children."

Brau, Eduard Hinrich (A.M., Duke University). Economics. Dissertation: "A National Income, Trade-Flow, Capital-Flow Model of the United States and the United Kingdom: A Simulation Study."

Breen, Joseph John (B.S., Fairfield University). Chemistry. Dissertation: "Nuclear Magnetic Resonance Studies of Some Cyclic Phosphorus Compounds."

Brehm, Sharon Stephens (A.B., Duke University; A.M., Harvard University). Psychology. Dissertation: "Developmental Aspects of Objective Self Awareness."

Butler, Gerald Allan (A.B., Hampden-Sydney College; B.D., Union Theological Seminary). Religion. Dissertation: "Karl Barth and Political Theology."

Caldwell, Wayne Troy (A.B., University of North Carolina; A.M., Appalachian State University). English. Dissertation: "'Affliction Then Is Ours': George Herbert's *The Temple* as an Anatomy of Religious Melancholy."

Campbell, Dennis Marion (A.B., Duke University; B.D., Yale University). Religion. Dissertation: "Authority and the Renewal of Theology in America: An Historical Study and Contemporary Critique."

Caplan, Paula Joan (A.B., Radcliffe College; A.M., Duke University). Psychology. Dissertation: "Sex Differences in Determinants of Antisocial Behavior."

Casagrande, Vivien Alice (A.B., University of Colorado). Psychology. Dissertation: "Behavioral Changes Following Ablation of the Superior Colliculus in the Tree Shrew (*Tupaio glis*)."

Chase, Philander Dean (A.B., North Carolina State University; A.M., Duke University). History. Dissertation: "Baron von Steuben in the War of Independence."

Cherniack, Saralee Faerman (A.B., University of Manitoba; A.M., University of California). Psychology. Dissertation: "Affiliation, Small Group Structure, and Accuracy of Person Perception."

Church, Roderick Allan (A.B., University of British Columbia; A.M., Duke University). Political Science. Dissertation: "The Politics of Administration in Urban India: Citizens, Municipal Councillors, and Routine Administration in Lucknow."

Churchill, Larry Raymond (A.B., Southwestern at Memphis; M.Div., Duke University). Religion. Dissertation: "Saying and Knowing: Toward a Post-Critical Philosophy of Language."

Cohen, Ralph Alan (A.B., Dartmouth College; A.M., Duke University). English. Dissertation: "London and the Techniques of Setting in Ben Jonson's Comedies."

Christo, Anthony B. (A.B., University of Maine; M.B.A., University of Pennsylvania). Education. Dissertation: "The Development of the Community College System in Virginia to 1972."

Crow, Peter Glenn (A.B., Davidson College; A.M., Florida State University). English. Dissertation: "Faulkner's Vitalistic Vision: A Close Study of Eight Novels."

Cudlin, Joseph John (B.S.M.E., Duke University). Mechanical Engineering. Dissertation: "Performance Characteristics of a Pneumatic Tube Transportation System."

Darnell, David Rancier (A.B., Florida Christian College; B.D., Texas Christian University). Religion. Dissertation: "Rebellion, Rest, and the Word of God (An Exegetical Study of Hebrews 3:1-4:13)."

Day, Fleming Howard (B.S., High Point College). Chemistry. Dissertation: "The Polar 1, 4-Cycloaddition of Isoquinolinium Salts."

DiCorcia, Joseph Nicholas (A.B., Yale University; A.M., Duke University). History. Dissertation: "Parisian Society, 1740-1763: A Cross-Sectional Analysis."

Dionne, Russell Jude (A.B., Tulane University; A.M., University of Southwestern Louisiana). History. Dissertation: "Government Directed Agricultural Innovation in India: The British Experience."

Dobelstein, Andrew W. (A.B., Valparaiso University; M.S., Case Western Reserve University). Political Science. Dissertation: "Public Welfare in the American System: The North Carolina Experience."

Dorf, Martin Edward (A.B., Rutgers University). Microbiology and Immunology. Dissertation: "Cross Reactions of HL-A Antibodies."

Douglass, Robert Bruce (A.B., College of William and Mary; M.Div., Yale University). Political Science. Dissertation: "What is Political Knowledge? An Inquiry into the Epistemological Foundations of Modern Political Science."

Downing, Jerry Nixon (A.B., Oklahoma University). Psychology. Dissertation: "Psychological Characteristics of Creative Inspiration and the Ideational Creativity/Intelligence Contrast."

Dunlop, Charles E. M. (A.B., Stanford University; A.M., Duke University). Philosophy. Dissertation: "An Analysis of Dreaming."

Edquist, Manuel Harty (A.B., Rice University). Psychology. Dissertation: "Interpersonal Choice and Social Attraction Among Four Interpersonal Types."

Fairbairn, James Ronald (A.B., Baylor University; B.D., Southern Baptist Theological Seminary). Religion. Dissertation: "The Achievement of a Human Existence. A Critique of Erich Fromm's Philosophical Anthropology."

Farnill, Douglas (A.B., Sydney University; B.S., S.T.M., Yale University) Psychology. Dissertation: "Inferential Set and Children's Use of Intention in Their Social Judgments."

Fischer, Susan Leibowitz (A.B., Cornell University; A.M., University of Illinois). Romance Languages. Dissertation: "Psychological and Esthetic Implications of Role-Change in Selected Plays by Calderón."

Foster, James Joseph (A.B., Johns Hopkins University; A.M., Duke University). English. Dissertation: "The Influence of Medieval Mythography on John Gower's *Confessio Amantis*."

Furniss, John Neilson (A.B., Washington and Lee University; A.M., University of Alabama). English. Dissertation: "George Eliot and the Protestant Work Ethic."

Goellner, Gregory James (B.S., Canisius College). Physics. Dissertation: "The Vapor Pressure of He³-He⁴ Mixtures Near the Tricritical Point."

Graf, Lloyd H., Jr. (B.S., University of Delaware). Microbiology. Dissertation: "A Pleiotropic-Negative Mutation and Its Suppression in *Solomonella typhimurium*."

Harmon, Elson Thomas (A.B., Princeton University; A.M., Duke University). English. Dissertation: "A Study of the Religious Works of Nicholas Breton."

Harms, Jan Christopher (B.S., University of Idaho; M.F., Duke University). Forestry. Dissertation: "Networks and Decomposed Linear Programming for Scheduling Forest Production."

High, William Lank, Jr. (A.B., Duke University). Physiology and Pharmacology. Dissertation: "The Role of Metabolism in Controlling Acid Secretion by Frog Gastric Mucosa."

Horowitz, Alan Jay (A.B., Harvard University). Physiology and Pharmacology. Dissertation: "Gangliosides of Rat Brain: Normal Development and Pharmacologic Influences."

Hosier, Paul Edward (B.S., State University of New York; A.M., University of Massachusetts). Botany. Dissertation: "The Effects of Oceanic Overwash on the Vegetation of Core and Shackleford Banks, North Carolina."

Kirkham, Donald Henry (A.B., M.Ed., University of Sydney; B.D., Drew University). Religion. Dissertation: "Pamphlet Opposition to the Rise of Methodism: The Eighteenth-Century English Evangelical Revival Under Attack."

Klein, Fritz Ferdinand (B.S., M.S., University of New Hampshire). *Electrical Engineering*. Dissertation: "A Method of Signal Analysis Applied to the Human EEC."

Korenbrot, Carol Cleaves (A.B., Cornell University). *Physiology and Pharmacology*. Dissertation: "Estradiol in Ring Doves (*Streptopelia risoria*)."

Kuonen, Ernest Anthony (B.S., Florida Atlantic University; M.S., University of Rhode Island). *Mechanical Engineering*. Dissertation: "Momentum and Heat Transfer in a Branched Model of the Lower Respiratory Tract."

LaFleur, Richard Allen (A.B., A.M., University of Virginia). *Classical Studies*. Dissertation: "A Prosopographical Commentary on Juvenal, Book One."

Lau, Henry (B.S., University of Tennessee; M.S., Duke University). *Mechanical Engineering*. Dissertation: "Performance of Externally Pressurized Compliant Bearings for Tube Vehicle Suspensions."

Little, James Crichton (Diploma, Glasgow University; B.D., Duke University). *Religion*. Dissertation: "Redaction Criticism and the Gospel of Mark with Special Reference to Mark 4:1-34."

Luhan, Patricia Abel (B.S., St. Mary-of-the-Woods; M.S., University of Dayton). *Chemistry*. Dissertation: "Structure and Conformation Studies of Some Organic Molecules by X-Ray Diffraction Methods."

Lytle, Leslie Thomas (B.S., University of Cincinnati; A.M., Duke University). *Chemistry*. Dissertation: "Reductions of 13-Oxyprotoberberinium Salts and Related Systems."

Malinowski, Francis X. (A.B., St. Mary's Seminary; S.T.B., Fribourg University). *Religion*. Dissertation: "Galilean Judaism in the Writings of Flavius Josephus."

Margerison, Kenneth Hilton, Jr. (A.B., University of North Carolina; A.M., Duke University). *History*. Dissertation: "The Revolutionary Thought and Activity of Pierre-Louis Roederer."

Martinez-Vargas, Marie Christine (Science Diplomie, University of Paris). *Psychology*. Dissertation: "The Induction of Nest Building in the Ring Dove (*Streptopelia risoria*): Hormonal and Social Factors."

Matthews, William H. (A.B., Davidson College). *Physiology and Pharmacology*. Dissertation: Effects of Vagal Nerve Block on Respiratory Cycle Parameters."

McDowell, Maxson John (B.Sc., University of Otago). *Microbiology and Immunology*. Dissertation: "The Translation of Messenger RNA into Reovirus Polypeptides by Several Mammalian Cell-Free Systems."

Miller, Donald Max (B.S., Florida State University; M.D., Duke University). *Biochemistry*. Dissertation: "Characterization of the Acetylation of the Arginine-Rich and Slightly Lysine Rich Histones."

Mishler, William Thomas Earle, II (A.B., Stetson University; A.M., Duke University). *Political Science*. Dissertation: "Political Participation and the Process of Political Socialization in Canada: A Computer Simulation."

Mulligan, Paul F., Jr. (A.B., St. Peter's College). *Economics*. Dissertation: "Government Functions in an Underdeveloped Free Enterprise Economy: The Economic System of Liberia."

Nay, Richard Alan (B.S.E., M.S., Duke University). *Civil Engineering*. Dissertation: "An Alternative for the Finite Element Method."

Neilson, Robert Hugh (B.S., Carnegie-Mellon University). *Chemistry*. Dissertation: "Synthesis and Variable Temperature Proton NMR Studies of Some N-Trimethylsilyl-Germyl, and -Stannyli Substituted Aminoboranes."

Olshan, Arthur R. (A.B., Brooklyn College). *Biochemistry*. Dissertation: "The Regulation of the Isoleucine-Valine Biosynthetic Enzymes in *Neurospora crassa*."

Olsene, Andrée Lévesque (A.B., Université Laval; A.M., Duke University). *History*. Dissertation: "The Canadian Left in Quebec During the Great Depression: The Communist Party of Canada and the Cooperative Commonwealth Federation in Quebec, 1929-39."

Perkins, Raymond Keller, Jr. (A.B., Colby College). *Philosophy*. Dissertation: "Meaning and Acquaintance in the Early Philosophy of Bertrand Russell."

Peters, William Carter (B.S., Richmond College). *Physics*. Dissertation: "Electromagnetic Decay of Fragmented Analogue States in ⁵⁵Mn and ⁵⁵Co."

Pharr, Philip Allen (A.B., Pfeiffer College; B.D., Th.M. Duke University). *Religion*. Dissertation: "The Passion Narrative of the Fourth Gospel: A Study of Sources in John 18:1-19:42."

Probst, Robert Edward (A.B., Amherst College; M.A.T., Johns Hopkins University). *Education*. Dissertation: "Literature as a Mode of Knowing: Rationale for the Teaching of Literature."

Pubantz, Jerret James (B.S.F.S., Georgetown University; A.M., Duke University). *Political Science*. Dissertation: "Marxism-Leninism and Soviet Foreign Policy Decision-Making Vis-a-vis the United States, 1956 to 1972."

Rackley, Sally Ann (A.B., Colby College; A.M., University of Wisconsin). *Classical Studies*. Dissertation: "The Amatory Poems of Ovid in Four Manuscripts of the Florilegium Collicum."

Reid, Suzanne Ellen (A.B., Randolph-Macon Women's College; A.M., Duke University). *Economics*. Dissertation: "Corporate Simulation: A Theoretical Approach."

Remnek, Richard Barry (A.B., Brandeis University; A.M., City University of New York). *Political Science*. Dissertation: "The Role of Soviet Scholars in the Formulation of Soviet Policy Towards India, 1947-1971."

Rhea, Thomas Clark Rye, Jr. (A.B., King College). *Physics*. Dissertation: "Polarization and Cross-Section Studies of the ¹²C(³He, no/ and ⁽¹³C(³He,no/ Nuclear Reactions and of ¹³C(³He,³He) Elastic Scattering.)"

Rhoads, David Michael (A.B., Gettysburg College; B.D., Gettysburg Seminary). *Religion*. Dissertation: "Some Jewish Revolutionaries in Palestine from 6 A.D. to 73 A.D. According to Josephus."

Robinder, Ronald C. (A.B., Linfield College; A.M., Duke University). *Chemistry*. Dissertation: "Low Frequency Electrical and Electro-Optical Studies on Non-Oriented Thick Films of Four Liquid Crystalline Materials."

Roche, Arthur John, III (A.B., Marquette University; A.M., Fordham University). *English*. Dissertation: "A Literary Gentleman in New York: Evert A. Duyckinck's Relationship with Nathaniel Hawthorne, Herman Melville, Edgar Allan Poe, and William Gilmore Simms."

Sahaphong, Somphong (M.D., University of Medical Sciences, Thailand). *Pathology*. Dissertation: "The Role of Cell Membrane Sulphydryl Groups in Pathogenesis of Cell Death."

Sander, William August, III (B.S., Clemson University; M.S., Duke University). *Electrical Engineering*. Dissertation: "Static DC to DC Power Conditioning-Active Ripple Filter, 1 MHz DC to DC Conversion, and Non-linear Analysis."

Scott, Joyce Alaine (A.B., University of Connecticut; A.M., University of Virginia). *Romance Languages*. Dissertation: "Douceur and Violence in the Tragedies and Tragi-Comedies of Philippe Quinault."

Short, Douglas Dean (A.B., Stetson University; A.M., Duke University). English. Dissertation: "The Old English Gifts of Men: A Critical Edition."

Shoulders, Eugene (B.S.F., West Virginia University; M.F., Louisiana State University). Forestry. Dissertation: "Rate of Nutrient Uptake by Slash Pine as a Function of Environmental Factors."

Sims, Herbert Percival (B.S.F., University of British Columbia; M.F., Yale University). Forestry. Dissertation: "Some Ecological Effects of Prescribed Burning on Cut-Over Jack Pine (*Pinus banksiana* Lamb.) Sites, Southeastern Manitoba."

Soile, Sola (A.B., University of Ife; A.M., Duke University). English. Dissertation: "The Myth of the Archetypal Hero in Two African Novelists: Chinua Achebe and James Ngugi."

Solomon, Harry Miller, Jr. (A.B., Stephen F. Austin University; A.M., Duke University). English. Dissertation: "The Poetry of Jonathan Swift."

Stauter, Mark Cordell (A.B., University of Michigan; A.M., Duke University). History. Dissertation: "The Rural Electrification Administration, 1935-1945."

Stocks, Ronald Charles (B.S., Huron College; A.M., University of South Dakota). Chemistry. Dissertation: "I. The Synthesis and Reactions of Some Keto Derivatives in the Phospholane Family. II. The Synthesis and Stereochemistry of 1-Phenyl-2, 5-dimethylphospholene Derivatives."

Thomason, Michael Gary (B.S., Clemson University; M.S., Johns Hopkins University). Electrical Engineering. Dissertation: "New Theoretical Results in Fuzzy Automata and Their Application to Error Control in Regular Languages."

Thompson, Charles Allen (A.B., Duke University; LL.B., Columbia University; M.A., University of Cape Town). History. Dissertation: "The Administration of Sir Henry Loch as Governor of Cape Colony and High Commissioner for South Africa, 1889-1895."

Toepel, Lori Reed (A.B., New York University; A.M., Yale University). Classical Studies. Dissertation: "Studies in the Administrative and Economic History of Tebtunis in the First Century A.D."

Verich, Thomas Michael (A.B., Lawrence University; A.M., Duke University). History. Dissertation: "The European Powers and the Italo-Ethiopian War 1935-1936: A Diplomatic Study."

Vest, James Murray (A.B., Davidson College). Romance Languages. Dissertation: "Narrator Commentary in Scarron's *Roman Comique*, *Furetière's Roman Bourgeois* and Diderot's *Jacques le Fataliste*."

Walaskay, Paul William, Jr. (A.B., Wayne State University; B.D., Colgate-Rochester Divinity School). Religion. Dissertation: "'Koi houtos eis ten Romen elthomen': The Political Perspective of St. Luke."

Wall, John William (A.B., Ohio State University; A.M., Duke University). Economics. Dissertation: "External Economics and Localization in Small Scale Industry: A Case Study of the Bicycle Manufacturing Industry in Ludhiana District, India."

Wall, Judy Davis (A.B., University of North Carolina). Biochemistry. Dissertation: "An Investigation of the Mechanism of Generalized Transduction Mediated by Bacteriophage Pl."

Weaver, John Charles (A.B., Queen's University; A.M., Duke University). History. Dissertation: "Imperilled Dreams: Canadian Opposition to the American Empire, 1918-1930."

Weiss, Shirly Friedlander (A.B., Rutgers University; M.R.P., University of North Carolina). Economics. Dissertation: "New Town Development in the United States: Experiment in Private Entrepreneurship."

Wexler, John P. (B.S., Hobart College). Physiology and Pharmacology. Dissertation: "Pathways of Intermediate Metabolism in Normal and Reserpine Treated Tetrahydromano."

Wiggins, Richard Calvin (B.S., Duke University). Anatomy. Dissertation: "Multiple Hemoglobins of Orangutans (*Pongo pygmaeus*): Partial Amino Acid Sequences of Two Alpha Chains."

Wildgen, Kathryn Eberle (A.B., Loyola University). Romance Languages. Dissertation: "Intellectualism, the Ultimate Value in Novels of Francois Mauriac."

Wortman, Camille Badzgan (A.B., Duke University). Psychology. Dissertation: "Some Determinants of Perceived Control."

ADVANCED DEGREES CONFERRED SEPTEMBER 1, 1973

Master of Arts

Ayres, Sandra Lea	Gill, Robert Monroe	Menefee, John Alsworth
Baer, Jack Edward	Harmon, Carol Jean	Mowrey, Jean Diane
Bell, Sherry Karen	Hartzell, Dennis Jeffrey	Mudge, Anne White
Bellamy, Elizabeth Jane	Hecht, Irene Diamant	Mulroy, Juliana C.
Bernal, Ellen Wells	Herzog, Kristin K. H.	Myers, Sue Ellen
Bobo, Preston Bolt, Jr.	Jenks, Carl Major	Myers, Terry Owen
Bouknight, James Gilder	Jenks, Margaret Sarles	Newell, John Howle, Jr.
Buxton, John Haydn	Keane, Michael Andrew	Pacheco, Jaime M.
Carney, Elizabeth Donnelly	Keller, Paul Martin	Peterson, Angela J.
Chen, Shian-Jen Liu	Keough, David Andrew	Polemenakos, Sotiros Christos
Crissman, Stephen Craig	Kimball, Jane Anne	Rogers, Barbara Jean
Crowell, James Allen, Jr.	Kneisel, Billie Bryant	Sanders, Julia Parrish
Duffy, Edward J.	Kolesar, Janet DeVitis	Schroeder, Donald Norman
Dundas, Anthony J.	Krivatsy, Christina M.	Siler, Duane Alan
Elliott, Paul Charles	Lader, James Ira	Sire, Paul William
Emerson, Lynda Luther	do Lago, Luiz Aranha Correa	Smith, Nicholas Arthur
Ford, Roger Henry	Lastrapes, Charlene	Soldo, Mary Elizabeth
Ford, Steven James	Lollar, Larry Jon	Solomon, Deborah Jo
Fraker, George Alan	Lynch, Edward John	Spencer, Leo Joseph, Jr.
Galbraith, James Wright	Manoleahagul, Pisarn	Tapon, Francis
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Master of Arts in Teaching

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Bruhwel, Roger Alfred
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Clough, Charles Herbert
Collins, Bobby McManus
Copacino, John Michael
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Etheredge, Martha Stevenson
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Jordan, Barbara Faye
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Pate, Richard Allen
Pierce, Francis Xavier, II
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Rowe, Robert Randolph
Sayer, Dennis Gary
Seaks, Jane Lewis
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Thompson, Byron Glen
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Tuck, Selma Theresa
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Master of Education

Abondolo, Patricia Bullard
Abondolo, Stephen Joseph
Barber, Linda Faye
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Carnevale, Dorothy Dennis
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Clayton, Patricia Marie
Courtney, Henry Harward
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Hall, Nancy Dove
Harris, Bishop T.
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Neal, Kenneth Harlon
Parker, Salli Jane
Posner, Cheryl Lynn

Rogers, James William
Rogers, Jean Hilton
San Miguel, Barbara Ann
Slaughter, Judith Pollard
Stevens, Jane Sexton
Tyor, Regina Lynn
Williams, Frances Lonnette
Yohe, Virginia Wilson

Master of Science

Douglass, Rodney Wayne
Evans, Madeline Kay
Keplinger, Craig Alan

Konath, Prabhakar
Roebuck, John Richard, Jr.

Sutherland, Joseph Edward
Sweitzer, Linda Gray

Master of Hospital Administration

Brewer, Richard Frederick, III

Harmon, Conley

Kruska, Ellen Ruth

Master of Business Administration

Mohr, Daniel Eugene

Doctor of Education

Flint, Lowell Truman (A.B., Marion College; M.Ed., University of North Carolina). Education. Dissertation: "A Methodology for Deriving Behavioral Objectives for Student Personnel Programs."
LeBar, John Albert (B.S., Kansas State College; M.S., Kansas State Teachers College). Education. Dissertation: "An Analysis and Comparison of Factors in the Achievement Levels of Selected Duke University Graduates 1959-1960-1961."
Patton, Elbert Roy (B.S., Concord College; A.M., Marshall University). Education. Dissertation: "A Comparison of Transactional Analysis Group Counseling and Client-Centered Individual Counseling of Admissions Risk College Freshmen."

Doctor of Philosophy

Adams, Stanley Laytar (B.S., Drexel University; M.S., Florida Institute of Technology). Electrical Engineering. Dissertation: "The Theory of Signal Detectability: Extension to Optimum Arrays."
Alexander, Elaine Elliston (A.B., University of Alabama; A.M., Duke University). Mathematics. Dissertation: "Stirling and Eulerian Operators."
Barrow, Robert Oritsegbesimi (B.Sc., University of Ibadan). Microbiology and Immunology. Dissertation: "Studies on the Occurrence and Biosynthesis of the 2-Amino-2, 6-Dideoxyhexoses, Quinovosamine and Fucosamine, in Bacteria."

Beall, Larry Gilbert (A.B., State University of New York; A.M., University of South Carolina). Economics. Dissertation: "The Market Mechanism in Health Care Delivery: A Study of the Structure and Incentives."

Breytspraak, Linda Marshall (A.B., Colorado College; A.M., Duke University). Sociology. Dissertation: "The Impact of Achievement on the Self-Concept in Middle- and Older-Aged Adults."

Brunner, Larry George (A.B., McMurry College; A.M., Duke University). English. Dissertation: "The Doctrine of Subjective Salvation in the Poetry of W. B. Yeats."

Carlson, Patricia Ann (A.B., College of William and Mary; A.M., Duke University). English. Dissertation: "Hawthorne's Functional Settings: A Study of Artistic Method."

Chase, Carole Frederica (A.B., College of William and Mary; A.M., Presbyterian School of Christian Education). Religion. Dissertation: "Authority, Identity, Responsibility: A Christian Ethical Analysis of the Current Youth Ethos."

Chou, David Shieh (A.B., National Chengchi University; A.M., Duke University). Political Science. Dissertation: "China and U.N. Decolonization, 1946-1971."

Cozart, David Lee (B.S., Guilford College). Mathematics. Dissertation: "The Nonstandard Analysis of Locally Convex Riesz Spaces."

Davis, John Michael (A.B., Concord College). Psychology. Dissertation: "Socially Induced Flight Reactions in Pigeons."

Davis, Pamela Bowes (A.B., Smith College). Physiology and Pharmacology. Dissertation: "Studies of Deoxyribonucleic Acid Polymerase During Regeneration of Rat Liver."

De Chaine, James Anthony (A.B., Saint John's University; M.Ed., Duke University). Education. Dissertation: "The Residence Hall: An Analysis of Its Physical Characteristics and Social Composition."

Delgadillo M., Claudio (B.S., Universidad Nacional Autónoma De México; M.S., University of Tennessee). Botany. Dissertation: "A Taxonomic Revision of Aloino, Aloinello, and Crossidium (Musc.)".

Diognan, Glenn Alan (B.S., Bucknell University). Chemistry. Dissertation: "Part I. The Reaction of a Bridgehead Sulfonium Salt with Nucleophiles. Part II. An Investigation of the Steric Requirement of a Sulfur Lone Pair by Carbon-13 Nuclear Magnetic Resonance. Part III. Synthetic Routes to the 3-Oxatricyclo-(4.4.0.0^{1,7}) Decane Skeleton."

Fedak, Michael Andre (A.B., Rutgers University). Zoology. Dissertation: "Energy Cost of Bipedal Running."

Fischer, Linda Anne (A.B., Rutgers University; A.M., Northwestern University). Sociology. Dissertation: "Medical Care Utilization: An Attempt to Integrate Theories and Survey Results."

Gailey, Kenneth Durwood (A.B., University of Maine). Chemistry. Dissertation: "Optical Activity and Absorption Studies of Hexaaquo Metal (II) Ions in Chiral Crystals: a-Zn(M)(H₂O)₆SeO₄ and Mg(M)(H₂O)₆SO₄."

Gerdes, John Leslie (A.B., Harvard University). Psychology. Dissertation: "Attribution of Responsibility for Failure, Stability of Failure, Achievement Motivation, and Help-Seeking."

Giles, Harold Frazee, Jr. (B.S., Lebanon Valley College; M.S., Wake Forest University). Chemistry. Dissertation: "The Crystal, Molecular, and Electronic Structures of Selected Transition Metal Complexes."

Grandstaff, Peter John (A.B., Union College). Economics. Dissertation: "Economic Aspects of Interregional Migration in the U.S.S.R., 1959-70."

Grawe, Hartmut (A.B., Free University of Berlin; A.M., Duke University). Political Science. Dissertation: "Comparative Politics and Political Development: A Survey of the Literature and Phenomenological Consideration of Analytic and Normative Dilemmas in Research."

Hall, James Lyman (A.B., Dartmouth College; M.D., University of Michigan). Pathology. Dissertation: "Purification and Characterization of Humoral Recognition Factors in the American Lobster, Homarus americanus."

Hamilton, Daniel Lee (B.S., Pennsylvania State University). Microbiology and Immunology. Dissertation: "Bacteriophage T4D Head Morphogenesis: Properties of Potential Intermediate Head Structures Which Accumulate as a Result of Mutations in Gene 13 or Gene 24."

Hanigan, James Patrick (A.B., A.M., Fordham University; M.Div. Woodstock College). Religion. Dissertation: "Martin Luther King, Jr., and the Ethics of Militant Nonviolence."

Hayes, William M. D. (A.B., St. Mary's Dominican College; A.M., Aquinas Institute). Religion. Dissertation: "The Freudian Vision in Three Contemporary Psychiatric Writers."

Huntington, William Richard (A.B., Duke University). Anthropology. Dissertation: "Religion and Social Organization of the Bara People of Madagascar."

Jorgensen, Richard Stanley (A.B., Dana College; A.M., Duke University). History. Dissertation: "The Kingship of William III, 1689-1697."

Joyner, Ronald Wayne (B.S., University of North Carolina). Physiology and Pharmacology. Dissertation: "Measurement and Analysis of Ionic Currents at the Squid Giant Synapse."

Karnovsky, Denis Stanley (A.B., Blackburn College; A.M., University of Missouri). Economics. Dissertation: "The Effect of Market Expectations on Employment, Wages, and Prices."

Keith-Lucas, Timothy (A.B., Swarthmore College). Psychology. Dissertation: "Avoidance Learning to Stimulus Objects Presented Following Shock."

Kello, John Edward (B.S., Old Dominion College). Psychology. Dissertation: "Observation of the Behavior of Rats Running to Reward and Nonreward in an Alleyway."

Kennedy, John Gerald (A.B., Grove City College; A.M., Duke University). English. Dissertation: "The Test of Reason: Realistic Techniques in the Fiction of Edgar Allan Poe."

Klein, Albert William (A.B., Washington and Jefferson College). Anatomy. Dissertation: "Studies in the Lung Development of Normal and Stressed Fetal Rats and Guinea Pigs."

Levy, Nelson Louis (A.B., Yale University; M.D., Columbia University). Microbiology and Immunology. Dissertation: "Immunologic Aspects of Human Intracranial Neoplasms."

Lisowski, Paul William (B.S., University of Virginia; M.S., University of Mississippi). Physics. Dissertation: "The Transfer Polarization of the D(d, n)³He Reaction and the Scattering of Polarized Neutrons from ⁴He and ³He."

Loftis, Alton Taylor (A.B., University of North Carolina; A.M., Duke University). English. Dissertation: "A Study of Russell's Magazine: Ante-Bellum Charleston's Last Literary Periodical."

Lohrbauer, Linda Gertner (A.B., University of Florida; A.M., University of Tennessee). Education. Dissertation: "The Predictive Validity of a Test of Phonic Analysis Ability for First Grade Reading Achievement."

Loving, Jerome MacNeill (A.B., Pennsylvania State University; A.M., Duquesne University). English. Dissertation: "Civil War Letters of George Washington Whitman."

Mabli, Jerome (B.S., City University of New York; M.S., University of Bridgeport). Psychology. Dissertation: "The Risky Shift as a Function of Information About Others' Risk Levels."

Macdonald, Victor Winslow (A.B., Johns Hopkins University). Physiology and Pharmacology. Dissertation: "Spectrophotometric Studies on the pH of Frog Skeletal Muscle."

Marnett, Lawrence Joseph (B.S., Rockhurst College). Chemistry. Dissertation: "The Thermal and Photochemical Decomposition of Unsymmetric Azo Compounds."

Maulitz, Russell Charles (A.B., Harvard University; M.Sc., London University). History. Dissertation: "A Treatise on Membranes: Concepts of Tissue Structure, Function, and Dysfunction, from Xavier Bichat to Julius Cohnheim."

McCarty, Kenneth Scott, Jr. (B.S., M.D., Duke University). Pathology. Dissertation: "The Ribosome in Evolution: A Comparison of Mitochondrial and Cytoplasmic Ribosomes."

Moylan, Patricia Mary (A.B., University of Hartford; A.M., Rutgers University). English. Dissertation: "The Art of Persuasion in the Ancrene Riwle."

Murphy, Richard Joseph (A.B., University of Notre Dame; A.M., Loyola University). English. Dissertation: "The Artistic Unity of Jonathan Swift's *A Tale of a Tub*."

Neu, Martha Jean (B.S., Houghton College). Chemistry. Dissertation: "The Chemistry and Stereochemistry of the Isomeric trans-Bicyclo [2.2.1]-5-Heptene-3-Iodomethyl-2-Methylene Dimethysulfonium Iodide."

Page, Edward Walker, (B.S., Clemson University; M.S., University of Alabama). Electrical Engineering. Dissertation: "Programmable Array Realizations of Sequential Machines."

Proctor, Eugenia Christian (B.S., Denison University). Psychology. Dissertation: "Autonomic Arousal and Subjective Report of Anxiety and Behavior Under Stress."

Rose, Winfield Harrison (A.B., Carson-Newman College; A.M., Duke University). Political Science. Dissertation: "Referendum Voting and the Politics of Health Care in Durham County, North Carolina."

Sanders, Lee Alan (A.B., Swarthmore College). Biochemistry. Dissertation: "Studies of the Histone and Non-histone Chromosomal Proteins of Developing Avian Erythroid Cells."

Sharp, Henry Stephen (A.B., A.M., Lehigh University). Anthropology. Dissertation: "The Kinship System of the Black Lake Chipewyan."

Shepherd, Jan Monroe (A.B., Pfeiffer College). Chemistry. Dissertation: "Intramolecular Reactions of Some Endo-Dicyclopentadiene Derivatives."

Sosne, Howard Leonard (A.B., Adelphi University; M.S.T., State University of New York). Education. Dissertation: "A Management Information System Model Based on the Information Needs of a Prototype School District."

Staffa, Nickolas George, Jr. (A.B., Johns Hopkins University). Physics. Dissertation: "Shift of g_J (Rb^{87}) with Helium Gas Pressure."

Szal, Richard Joseph (B.S., University of Illinois; M.B.A., University of Hawaii). Economics. Dissertation: "Dynamic Aspects of the Long-run Distribution of Income: A Cohort Analysis."

von Ramm, Olaf Thomas (B.A.Sc; M.A.Sc., University of Toronto). Biomedical Engineering. Dissertation: "A Real Time Digitally Controlled Ultrasound Imaging System."

Wagor, Earl (A.B., University of California). Psychology. Dissertation: "Visual Functions of the Cortex: An Investigation Using the Methods of Behavioral Training and Cortical Ablation in the Grey Squirrel."

Weiner, Richard David (B.S., Massachusetts Institute of Technology; M.S.E., University of Pennsylvania). Physiology and Pharmacology. Dissertation: "Electrophysiologic Characteristics of Group Ia Synapses on a Spinal Alpha-Motoneurons in the Cat."

Wentworth, David Files (A.B., University of Vermont; A.B., M.S., University of Maine). Microbiology and Immunology. Dissertation: "Cooperativity in B-Isopropylmalate Dehydrogenase and Studies on the Formal Mechanism."

Wilson, William Monroe, Jr. (B.S., Florida State University). Physics. Dissertation: "A High Resolution Study of Proton Resonances in ^{41}Sc , ^{43}Sc , and ^{45}Sc ."

Index

Absence, Leave of, 60
Academic Probation, 60
Academic Regulations, 58-63
Administration
 Executive Committee of the Graduate Faculty, vii
 Graduate School Administration, vii
 University Administration, vii
Admission
 Application Fee, 46
 Application Deadlines, 47
 Examinations for, 46
 Foreign Students, Procedures for, 46
 Non-Degree, 47
 Notification of Status, 46-47
 Prerequisites, General, 45
 Provisional, 47
 Students Requiring, 45
Aging and Human Development, Center for the Study of, 15
Anatomy, 69-73
Ancient History, 94-95
Animal Behavior Station, 30
Anthropology, 73-75
Application Procedures, see Admission and Student Aid
Archeology, 95
Art, 75-77
Asia, Southern, Program in Comparative Studies on, 16
Asian Languages, 77
Assistantships: Graduate, Part-time Instruction, Research, 54-55
Audit Fee, 50
Awards, see Fellowships, Financial Information, Scholarships, Special Fellowships, and Student Aid
Biochemistry, 77-80
Botany, 80-83
 Laboratories, 29
 Tropical Biology Program, 23
Biomedical Engineering, 110-112
Business Administration, 83-89
Calendar, iv
Canadian Studies Program, 15-16
Chemistry, 89-92
 Laboratories, 31
Civil Engineering, 112-117
Class Size, 61
Classical Studies, 92-95
Commencement, 63
Commonwealth Studies, Center for, 16
Comparative Literature, 96
Computation Center, 33
Computer Science, 96-98
Conduct, Standards of, 63-65
Cooperative Program in Teacher Education, 17
 see also Master of Arts in Teaching
Cooperative Programs with Neighboring Universities, 17
 Library Exchange, 17
 Russian and East European History, 17-18
Counseling Center, 40
Course Load
 For Resident and *in absentia* Doctoral Students, 58
 For Resident and *in absentia* Master's Students, 58
In Summer Session, 59
See also Residence Requirements, Courses of Instruction (departmental and subject listings), 69-198; see also Independent Readings
Credit, Graduate
 Earned Prior to A.B. Degree, 59
 Earned under Reciprocal Agreements with Neighboring Universities, 59-60
For Courses Taken in the Law School, 59
Transfer of, 3, 59
See also Doctor of Philosophy and Master's Degrees (All), Time Limits
Deadlines
 Application, 47
 Dissertation, 11
 Intention to Graduate, 6
 Passing Foreign Language Requirement, 9
 Passing Preliminary Examination, 10
 Thesis, 4
Debts, 51
Degree Requirements, see Individual Degree Listings
Degrees Conferred, May 1973, 199
Degrees Conferred, September 1973, 203
Degrees Offered, 3-13
Demographic Studies, Center for, 18
Dissertation, see Relevant Doctoral Degree
Dissertation Expenses, 50
Doctor of Education Degree, Description and Requirements for, 12-13
Doctor of Philosophy Degree, 9-12
 Binding fees, 50
 Committee, Supervisory, 9
 Description, 9
 Deposit of Dissertation, 12
 Dissertation, 11-12
 Examinations, Final, 12; Preliminary, 10
 Expenses, Dissertation, 50
 Foreign Language Requirement, 9
 Major and Related Subject Requirements, 9
 Residence Requirements, 10
 Time Limitations, for Completion of, 10,
 Title, Filing of Dissertation, 12
Duke Forest, 35
Economics, 98-102
Education, 102-110
Electrical Engineering, 117-121
Engineering, 110-125
 Biomedical, 110-112
 Civil, 112-117
 Electrical, 117-121
 Laboratories, 33-35
 Materials-Fields, Mechanics Research Program, 20
 Mechanical, 121-125

English, 125-128
 English for Foreign Students, 62, 128
 Entrance Tests
 English Tests for Foreign Students, 46
 ETS Graduate School Foreign Language, 46
 Graduate Record Examination, 46
 Environmental Center, 18
 Faculty, viii-xix
 Faculty Ruling, 58
 Fees
 Athletic, 50
 Audit, 50
 Binding, 50
 Copyright, 50
 Late Registration, 57
 Microfilming, 50
 Motor Vehicle Registration, 50
 Transcript, 51
 Undergraduate Courses, 50
 Fellowships
 Canadian Studies, 52
 Endowed, 52
 Federal, 52
 Graduate, 52
 James B. Duke, 51
 Medieval and Renaissance Studies, 52
 Special Fellowships, 54
 See also Financial Information, Scholarships, Special Fellowships, and Student Aid
 Financial Information
 Audit Fee, 50
 Binding Fees, 50
 Assistantships, 54
 Change of Registration, 57-58
 Copyright Fee, 50
 Debts, 51
 Expenses, 51
 Fellowships, 51
 Food Services, 51
 Income Tax, 55
 Late Registration Fee, 57
 Leave of Absence, 60
 Living Accommodations, Cost of, 51
 Loans, 55
 Motor Vehicle Registration Fee, 50
 Scholarships, 51
 Teachers, Faculty Spouses, and Other, Special Tuition Rates for, 50
 Transcript Fee, 51
 Tuition and Fees, 49-51
 Undergraduate Course Fee, 50
 Food Services
 Description of Facilities, 38
 Estimated Costs, 38, 51
 Foreign Language Examination, 61
 Waiver of, 61
 Foreign Students
 Admission, Additional Procedures for, 46
 English Language Requirements for, 62
 Insurance, Required, 38-39
 Non-Credit English Course for, 128
 Medical Statement, 38-39
 Withdrawal or Interruption of Program, 60
 Forestry, 128-135
 Laboratories, 35
 French, see Romance Languages
 Gardens, Sarah P. Duke, 29
 Genetics, University Program in, 19, 135-137
 Geology, 137-138
 Germanic Languages and Literature, 138-140
 Grades, 60
 Graduate Fellowships, 52
 Graduate Record Examination, 46
 Graduate Student Association, 42
 Graduate Women's Club, 41
 Greek, see Classical Studies
 Health Administration, 140-142
 Health Program for Students, 38-39
 Hindi-Urdu, 77
 Hispanic Studies Program, 19-20
 History, 142-146
 History of Social Science, Program in, 19
 Housing, 37-38, 51
 Immunology, see Microbiology and Immunology
 Independent Readings, 69
 Institute of Policy Sciences and Public Affairs, 23
 Instructional Staff
 Emeritus Professors, xviii-xix
 Faculty Members, viii-xvii
 See also Courses of Instruction
 Insurance, 38-39
 Italian, see Romance Languages
 Judicial Code, 63-67
 Laboratories
 Animal Behavior Station, 30
 Botanical and Zoological, 29
 Chemistry, 31
 Computation Center, 33
 Duke Forest, 35
 Engineering Research, 33
 Forestry Sciences, 35
 Marine, 30
 Medical Sciences, Nanaline H. Duke, 32
 Physics, 30
 Phytotron, 30
 Primate Facility, 30
 Psychology, 32
 Language Requirements
 Acceptable Languages, 61
 Foreign Students, 62
 Special Reading Courses for, 62
 Undergraduate Courses, 62
 Latin, see Classical Studies
 Libraries, 27-28
 Holdings, 27
 Special Collections, 27-28
 Living Accommodations
 Cost of, 51
 Deposit for Reservation of, 51
 Description of, 37-38
 Loans, ; see also Financial Information

Management Sciences, see Business Administration

Marine Laboratory, 30; see also Botany, Chemistry, Zoology, and the University Program in Marine Sciences

Marine Sciences, University Program in, 146-147

Master of Arts Degree

- Examining Committee and Examination, 5
- Filing Intention to Graduate, 6
- Language Requirements, 5
- Major and Related Subject Requirements, 5
- Non-Thesis Option for Completion of Program, 5
- Prerequisites, 4
- Thesis, 4

Master of Arts in Teaching Degree

- Committee, 7
- Cooperative Program in Teacher Education, 17
- Prerequisites, 7
- Programs for Degree, 7
- Recommendation for Teacher Certification 4

Master of Business Administration, Description and Requirements for, 8-9

Master of Education Degree, Description and Requirements for, 6

Master of Hospital Administration Degree, Description and Requirements for, 7-8

Master of Science Degree

- Degree Requirements, 6
- Language Requirement, 6
- Prerequisites, 6
- Thesis and Examination, 6

Master of Science in Management Sciences, 88-89

Master's Degrees (All)

- Candidacy Requirements, 3-9
- Residence Requirements, 3
- Time Limits for Completion of, 4
- Transfer of Graduate Credit, 3
- See also individual degree listings

Materials-Fields-Mechanics Research Program, 20

Mathematics, 148-152

M.D.-Ph.D. Programs, 20-21

Mechanical Engineering, 121-125

Medical Historian Training Program, 21-22

Medical Scientist Training Program, 20-21

Medical Care, 38-39

Medieval and Renaissance Studies, Program in, 152-154

Microbiology and Immunology, 154-156

Motor Vehicle Registration, 50

Nervous System, Predoctoral Training Program in Sciences Related to the, 22

Non-Degree Admission, 47

Oak Ridge Institute of Nuclear Studies, 23

Organization for Tropical Studies, 23

Pathology, 156-159

Pharmacology, see Physiology and Pharmacology

Philosophy, 159-161

Physical Therapy, 161-163

Physics, 163-165

- Laboratories, 30

Physiology and Pharmacology, 165-170

Phytotron, 30

Placement Services, 40

Political Science, 170-175

Press, Duke University, 42

Program Information, 3-13

Provisional Admission, 47

Psychology, 175-178

- Laboratories, 32

Public Policy Sciences, 178-180

Reciprocal Agreements with Neighboring Universities, 59

Refund

- Tuition, 49-50
- Housing, 51

Registration,

- Change of, 57
- In Absentia, 57, 60-61
- Late, 57
- Periods, 57
- Reciprocal Agreements with Neighboring Universities, 59
- See also Calendar, Course Load

Related Fields, see Relevant Degree Program

Religion, 180-186

Research and Publications

- Duke University Press, 42

Residence Requirements

- Academic Regulations, 58-63
- Doctor of Education, 12
- Doctor of Philosophy, 10
- Master's Candidates in Summer Study Only, 3, 67
- Masters Candidates, General, 3
- See also Course Load

Romance Languages, 187-189

- French, 187-188
- Italian, 188
- Spanish, 188-189

Russian and East European History, Cooperative Program in, 17-18

Scholarships, see also Fellowships, Financial Information, Special Fellowships, and Student Aid

- Slavic Languages and Literatures, 189-191
- Social System Simulation Program, 24
- Sociology, 191-194
- Southern Studies, Center for, 24
- Spanish, see Romance Languages
- Special Fellowships
- Cokesbury Graduate Awards in College Teaching, 54
- Exchange Fellowships with the Free University of Berlin, 54
- Shell Fellowships (in African Studies), 54
- See also Fellowships

Stochastic Systems Program, 25

Student Affairs, 41-42

- Student Aid
 - Payment of Stipends, 55
 - Types Available, 51-55
 - See also Financial Information and Loans
- Summer Session
 - Description, 67
 - Regulations Governing, 67
- Teacher Certification, 4
- Teacher Education, Cooperative Program in, 17
- Thesis
 - Expenses, 50
 - See also Relevant Master's Degree
- Transfer of Graduate Credit, 3, 59
- Tuition and Fees
 - Adjustment with Change in Registration, 57
 - Audit Fee, 50
 - Dissertation Fees, 50
- Estimates, Table of, 51
- Special Fees for Teachers, Faculty Spouses, and Others, 50
- Stipends and Income Tax, 55
- Transcript Fee, 51
- Undergraduates
 - Courses Primarily for, 60
 - Duke Students, Graduate Credit for, 59
- Visiting Scholars, 42
- Withdrawal or Interruption of Program
 - For Foreign Students, 61
 - From Course, 60
 - From the Graduate School, 60
- Zoology, 194-198
 - Laboratories, 29
 - Tropical Biology Program, 23, 198



MAP OF DUKE UNIVERSITY

East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
D	Union Building
E	Faculty Apartments
F	Art Museum, Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
D	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building
	School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T,
	Clinical Research
J	Duke Hospital
K	Sociology, Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle
D	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Kigo Quadrangle
T	Union Building
U	Flowers Building
V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Laboratory
Z	Biological Sciences
AA	Plant Environment Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Research Buildings
GG	Nanaline H. Duke Medical Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House
	School of Nursing
KK	Hanes House Annex
LL	Pickens Rehabilitation Center
MM	Graduate Center
NN	Alumni House
OO	Commonwealth-Studies Center
PP	Personnel Office
QQ	International House
RR	Personnel Office
SS	Education Improvement Program, A Better Chance Program
TT	International Studies Center
UU	Campus Stores Office
VV	Office of Institutional Advancement
WW	Information Services
XX	Admissions Office
YY	Edens Quadrangle
ZZ	Wade Stadium





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